AKE FULL CONTROL OF YOUR WINDOWS APPS

a+pc

Feb 2017
Issue 438

YOUR E… TODAY'S TECH

AN EXPERT GUIDE TO REIGNING-IN RESOURCE HOGS + LOCKING-DOWN, INSTALLING, REMOVING AND SANDBOXING YOUR APPS

PLUS
CES 2017 SPECIAL
PREVIEW THE HOTTEST NEW PCs & TECH COMING THIS YEAR!

PRO PC GEAR

ALL THE PERFORMANCE, NONE OF THE BLING: PROFESSIONAL-GRADE MONITORS, MICE, KEYBOARDS + STORAGE DEVICES ROUNDED-UP & EXPERT TESTED!

+

TECH PROJECTS MADE EASY

- ANDROID HACKING BASICS: UNLOCK & ACCESS ADVANCED FEATURES & SETTINGS
- ANALYSE YOUR NETWORK'S TRAFFIC IN LINUX
- LO-FI MEETS RASP-PI IN OUR DIY WALKIE-TALKIE GUIDE!

TROUBLESHOOT CRASHES IN WINDOWS

LEARN HOW TO TRACK DOWN & RESOLVE THE CAUSES OF UNEXPECTED REBOOTS, BLUESCREENS OR MISBEHAVING APPS

AWESOME NEW TECH REVIEWED

- MSI'S LOUNGE ROOM FRIENDLY COMPACT GAMING PC
- A PRO SSD FOR PEANUTS? SAMSUNG'S 960 EVO ON TEST
- SEQUEL TO THE SMARTEST ROUTER WE'VE EVER TESTED

+ MORE INSIDE!

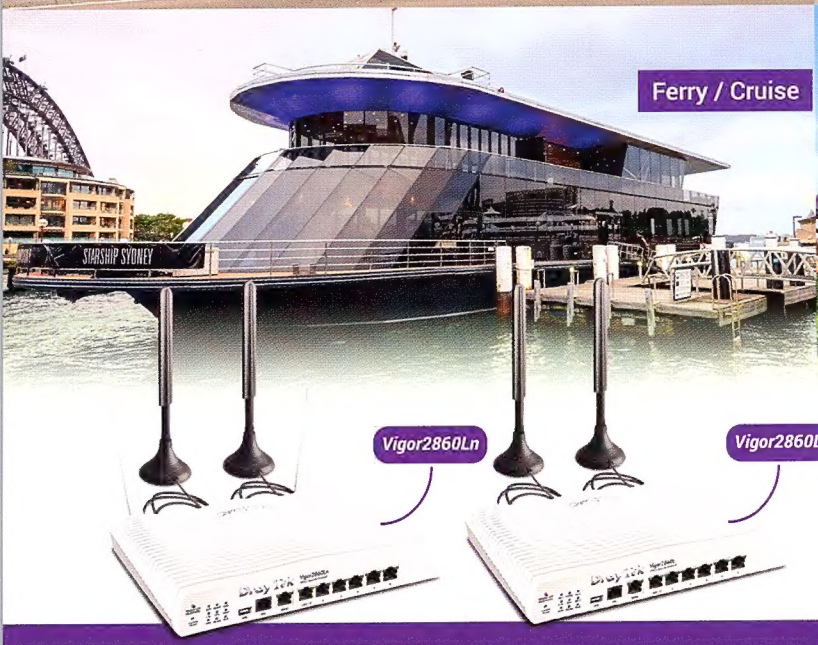
9 313006 001362
AUSTRALIA $9.95 • NEW ZEALAND $10.90 INC GST
PRINT POST APPROVED 100000079 • ISSN 0728-4415

4G LTE
Vigor2860L Series

Mobile Internet Solution for Small-to-Medium Businesses

4G LTE Multi-WAN router with SIM card slot (150/50 Mbps), VDSL2/ADSL2+, Gigabit Ethernet WAN, Security Firewall, 32 x VPN and 16 x SSL-VPN tunnels

DrayTek Aust & NZ
www.draytek.com.au



Aust / NZ VDSL NBN Ready | Ethernet WAN NBN Ready | Ethernet WAN UFB Ready | SIM Card | 32x VPN | TAIWAN EXCELLENCE 2015

- Card slot for a Frequency Division Duplex (FDD) 4G LTE SIM card
- Quad-WAN with 1 x built-in VDSL2 /ADSL2+ modem, 1 x Gigabit Ethernet WAN port, 1 x USB port and Wi-Fi WAN
- 6 x Gigabit LAN ports with 50,000 NAT sessions
- Load Balancing or Failover backup with ADSL/VDSL/Cable/Ethernet Broadband
- Built-in 802.11n Wireless for Vigor2860Ln
- Supports IPv6 standard
- Object-based SPI Firewall with Content Security Management (CSM)
- Supports QoS functions
- 32 x VPN and 16 x SSL-VPN tunnels with Load Balance and Redundancy
- Central VPN Management
- 1 x USB port supports 3G/4G modem, FTP server, network printer or temperature sensor
- Central AP Management
- Supports Smart Monitor Traffic Analyzer (up to 30 nodes)
- Supports VigorACS SI Central Management (TR-069)

4G LTE Specifications

- LTE/4G category 4
- 150 Mbps downstream and 50Mbps upstream
- 4G LTE band 800/900/1800/2600 MHz
- HSPA+ Band 1/8

i-LAN TECHNOLOGY

i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ
www.i-lan.com.au (02) 9838 8899 sales@i-lan.com.au

© Copyright February 2017 i-LAN Technology Pty Ltd. All rights reserved.

apc

Future Publishing Australia,
PO Box 1077, Mount Street, North Sydney, NSW 2059
Tel: 02 9955 2677 Fax: 02 9955 2688
SUBSCRIPTION ENQUIRIES: Please call Magshop 13 61 16
Email: apcmag@futurenet.com
Web: www.apcmag.com

EDITORIAL
Editor-in-Chief **Dan Gardiner**
Chief Sub-Editor / Journalist **Carmel Sealey**
Senior Journalist **Paul Taylor**
Senior Journalist **Shaun Prescott**
Journalist **Joel Burgess**
Journalist **Stephen Lambrechts**
Journalist **Sharmishta Sarkar**
Journalist **Harry Domanski**

ART/PRODUCTION
Creative Director **Troy Coleman**
Senior Designer **Nykke Coleman**
Designer **Sharnee Swinnerton**

CONTRIBUTORS
Graham Barlow, JR Bookwalter, George Cairns, David Chartier, Josh Collins, Alex Cox, Nate Drake, Cat Ellis, Craig Grannell, Matt Hanson, Jeremy Laird, Gary Marshall, Amber Neely, Nick Odantzis, Nick Peers, Alan Stonebridge, Zak Storey, Nathan Taylor, Alexander Tolstoy, Mihalis Tsoukalos, Mark Wilson, Darren Yates

SENIOR MANAGEMENT
Managing Director APAC **Neville Daniels**

COMMERCIAL
Sales Director **Paul Marttila**
paul.marttila@futurenet.com

ABOUT THE MAGAZINE
APC is published by Future Publishing Australia.

Distributed in Australia and NZ by Network Services.

Printed by Bluestar
All contents copyright Future Publishing (Overseas) Ltd, trading as Future Publishing Australia copyright 2013. All rights reserved. While all care is taken to ensure information is correct, please check prices and specifications before purchase.

PRIVACY STATEMENT
This issue of APC published by Future Publishing Australia may contain offers, competitions or surveys which require you to provide information about yourself if you choose to enter them or take part in them (Reader Offer). If you provide information about yourself to Future Publishing Australia, Future Publishing Australia will use this information to provide you with products or services you have requested, and may supply your information to contractors to enable Future Publishing Australia to do this. Future Publishing Australia will also use your information to inform you of other Future Publishing Australia publications, products, services and events. Future Publishing Australia may also give your information to organisations that are providing special prizes or offers and are clearly associated with the Reader Offer. Unless you tell us not to, Future Publishing Australia may give your information to other organisations that may use it to inform you of other products, services or events to give to other organisations that may use it for this purpose. If you would like to gain access to the information Future Publishing Australia holds about you please contact Future Publishing Australia's Privacy Officer.

Future

ABOUT FUTURE
Future Publishing Australia is part of Future plc. Future produces carefully targeted special-interest magazines, websites, and events for people who share a passion. We aim to satisfy that passion by creating titles offering value for money, reliable information, smart buying advice, and which are a pleasure to read or visit. Today we publish more than 180 magazines, websites and events, with over 100 international editions of our magazines published under license in 30 countries around the world. Future plc is a public company quoted on the London Stock Exchange (symbol: FUTR)

Chairman of the Board **Peter Allen**
Chief Executive Officer **Zillah Byng-Thorne**

FIPP

Top 25 Most Common Passwords of 2016

RANK	PASSWORD
1.	123456
2.	123456789
3.	qwerty
4.	12345678
5.	111111
6.	1234567890
7.	1234567
8.	password
9.	123123
10.	987654321
11.	qwertyuiop
12.	mynoob
13.	123321
14.	666666
15.	18atcskd2w
16.	7777777
17.	1q2w3e4r
18.	654321
19.	555555
20.	3rjs1la7qe
21.	google
22.	1q2w3e4r5t
23.	123qwe
24.	zxcvbnm
25.	1q2w3e

We still suck at passwords

APC editor Dan Gardiner wonders why, despite all the warnings, we're still leaving our best line of digital defence wide open.

Almost without fail, every new year, a bunch of news stories circulate about how terrible and insecure our passwords are. The 2016 list of the most common passwords once again tells that same terrifyingly mundane story: despite years of warnings, many people still use crap passwords. Using data that's been leaked after major site hacks, security firm Keeper Security scoured the login details of 10 million accounts and found that a whopping 17% of users were employing the password '123456'.

I do get it: passwords are hard. Having to invent different logins for every site and service you use would be a monumental task, so the temptation to take shortcuts is perfectly understandable. And I admit that, until about five or six years back, I was fairly lackadaisical when it came to passwords, too, having settled into the habit of re-using a handful of passwords across numerous sites. And in this age of ubiquitous hacks, where even big companies like Yahoo! are at risk, that's just asking to be fleeced. The problem with re-using the same password everywhere should be clear – if just one service gets hacked and that password gets leaked, the hacks will have the login for all your accounts.

As we've said previously in *APC*, using a password manager is the best choice. These make password security easy by automatically generating secure passwords and keeping an encypted database of them – so the only password you need to remember is the one to access your personal database. If you want an all-in-one solution, our current recommendation is LastPass (**www.lastpass.com**), a cloud-based service that you can access via the web and also has dedicated apps for Windows, Mac, iOS and Android. It's essentially free and once you start using it, it actually becomes *easier* than trying to remember a bunch of different passwords. So make the switch – you won't regret it.

DAN GARDINER
EDITOR-IN-CHIEF
dan.gardiner@futurenet.com

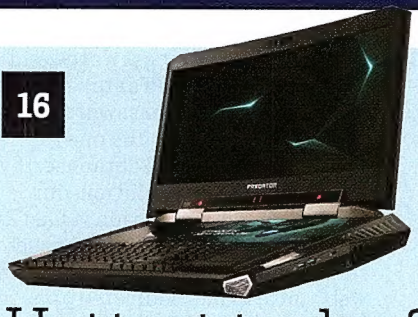
Contents

Issue 438 February 2017

39

PRO PC GEAR

ALL THE PERFORMANCE, NONE OF THE BLING: PROFESSIONAL-GRADE MONITORS, MICE, KEYBOARDS + STORAGE DEVICES ROUNDED-UP & EXPERT TESTED!



16

Hottest tech of CES 2017

WE HEAD TO LAS VEGAS' ANNUAL CONSUMER ELECTRONICS SHOW TO GET A SNEAK PEAK AT THE UPCOMING GADGETS, PCs, WEARABLES AND TRENDS.

» features

39 PRO PC GEAR

Expert tests and reviews of professional-grade monitors, mice, keyboards and NAS boxes:

40 Pro monitors put to the test
43 Advanced digital colour know-how
44 The keys to professional typing
57 Professional mice in focus
86 Backup basics covered: the best two-bay NAS boxes

66 TAKE FULL CONTROL OF YOUR WINDOWS APPS

Take control of your apps and you take control of your PC. We explain everything you need to know about managing your installed content.

» technotes

08 NEWS
The latest developments in the tech world.

10 NUMBER CRUNCH
The numbers behind the big tech news.

12 TECH BRIEF
The Internet of (really insecure) Things

13 HOW IT'S DONE
Razer OSVR HDK 2

14 EPINIONS
See what *APC*'s readers are talking about.

15 END USER
Can fair use get a fair shake in Australia?

"What's ominous about this piece of smart furniture is its ability to poke a baby if the crib doesn't detect a heartbeat for more than 12 seconds."
Hottest tech of CES 2017, page 16

23 MSI TRIDENT 3 VR7RC-05SEU

28 SEAGATE BACKUP PLUS PORTABLE 5TB

32 MIONIX NAOS QG

31 ASTRO GAMING A50 WIRELESS + BASE STATION

» the lab

22 LATEST REVIEWS

22 Acer Aspire Swift 7
23 MSI Trident 3
24 Synology RT2600ac
26 MSI Z270 XPower Gaming
27 ASUS Maximus IX Hero
28 Seagate Backup Plus drives
29 BitFenix Pandora
30 Roccat Cross
30 Razer Kraken
31 Astro Gaming A50
32 SteelSeries Arctis 3
32 Mionix Naos

34 SOFTWARE REVIEWS

34 Windows
35 Apple macOS
36 iPhone & iPad
37 Android
38 Linux

» how to

74 QUICK TIPS

We fix readers' computing problems

78 TUTORIALS

78 Troubleshoot Windows crashes
82 Record a podcast using your iPhone or iPad
84 How to switch seamlessly across Mac and iOS
86 Analyse network traffic in Linux
90 Create a Plex-powered media server

» how to

92 MASTERCLASSES

92 The ultimate PC upgrade
96 Build a walkie-talkie with a Raspberry Pi
100 Hack your Android
104 Arduino Troubleshooting 101
106 Python coding — Part 7: Object-oriented programming

» downtime

110 GAMES

High-performance playtime.

114 CHIP CHAT

News from the world of geekdom.

exclusive software

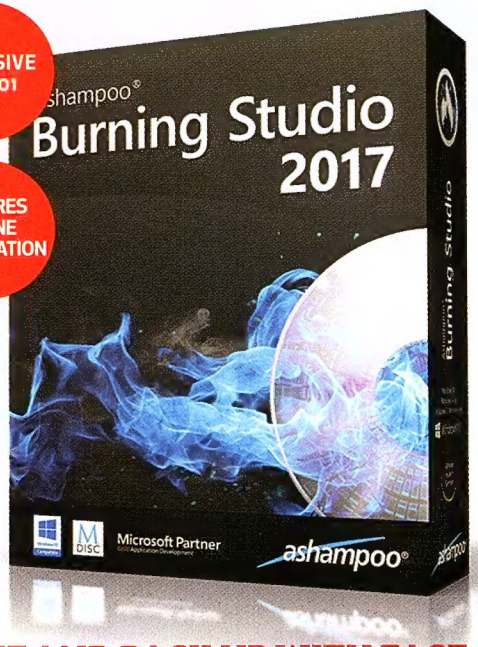
» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

ISSUE 438, FEBRUARY 2017

Please note that these exclusive downloads will only be available for a limited time, from **02/02/2017 to 22/03/2017.**

EXCLUSIVE GIFT 01

REQUIRES ONLINE REGISTRATION



CREATE AND BACK-UP WITH EASE

Own a full burning suite with Ashampoo's Burning Studio 2017

FULL VERSION REQUIRES ONLINE REGISTRATION.

Ashampoo Burning Studio 2017 is a powerful burning application that covers various use cases. It burns files, music or movies and extracts audio from CDs but also provides backup functionality for external devices such as flash drives, smartphones or tablets. The integrated cover editor helps with designing individual covers and booklets, and comes with multiple ready-to-use templates for quick results. Copying existing discs is effortless — this includes the creation, browsing and burning of disc images.

DOWNLOAD LINK: www.ashampoo.com/lpa/apc

EXCLUSIVE GIFT 02

FULL VERSION WORTH $15

NEVER LET FILE SIZE STOP YOU AGAIN

Scale back but retain quality with Abelssoft VideoCompressor

FULL VERSION WORTH $15.

Videos are a popular medium to share and spread experiences and information. But often users are confronted with videos being too large for sending and taking a lot of storage space on the hard drive or SD card. Abelssoft's VideoCompressor solves that problem and scales videos down significantly. It supports almost all popular formats like FLV, WMV, SWF, MPEG, MP4, 3GP, M4V, AVI, MKV, MOV, F4V and RM.

DOWNLOAD LINK: www.apcmag.com/exclusives
DOWNLOAD ZIP PASSWORD: February17f

DISCLAIMER Future Publishing is not the licensor of the exclusive software or any documentation included with it. Rather, Future is merely a distributor of the software, and your use of the software is subject to any accompanying third-party licence terms. You must carefully read and comply with any such third-party licence terms, together with all instructions and README files that come with the software. Accordingly, to the maximum extent permitted by law, all software is provided by Future 'as is' and without warranty either express or implied, and Future will not be liable for any damage that you may incur as a result of using any software downloads. You should back up any important system and data files before using any downloaded software. We recommend that you do not use the exclusive software on a production machine. Nothing in this disclaimer excludes any warranty that may be implied by statute, which may include the Trade Practices Act. While we have taken all reasonable steps to check the software downloads for viruses, we cannot guarantee that it is free from viruses or other harmful code and you should check each download using a virus scanner complete with the latest antivirus updates before use.

SUBSCRIBE & GET *APC* FROM ONLY $5.33 PER ISSUE!

12 ISSUES FOR ONLY $69

WHY SUBSCRIBE?

- Take advantage of our trial subscription offer of six issues for $45 if you choose to auto-renew*
- Get 12 issues of Australia's favourite tech mag for only $69!
- Take out a 2-year subscription and get 24 issues for $128 — that's only $5.33 per issue!
- Free delivery of every issue straight to your door
- Free full-version software downloads with every issue

SAVE UP TO $110!

TAKE FULL CONTROL OF YOUR WINDOWS APPS
apc
Feb 2017
Issue 438
AN EXPERT GUIDE TO REIGNING-IN RESOURCE HOGS + LOCKING-DOWN, INSTALLING, REMOVING AND SANDBOXING YOUR APPS
PLUS
CES 2017 SPECIAL
PREVIEW THE HOTTEST NEW PCs & TECH COMING THIS YEAR!
PRO PC GEAR
ALL THE PERFORMANCE, NONE OF THE BLING: PROFESSIONAL-GRADE MONITORS, MICE, KEYBOARDS + STORAGE DEVICES ROUNDED-UP & EXPERT TESTED!
TECH PROJECTS MADE EASY
ANDROID HACKING BASICS: UNLOCK & ACCESS ADVANCED FEATURES & SETTINGS
ANALYSE YOUR NETWORK'S TRAFFIC IN LINUX
LO-FI MEETS RASP-PI IN OUR DIY WALKIE-TALKIE GUIDE!
TROUBLESHOOT CRASHES IN WINDOWS
LEARN HOW TO TRACK DOWN & RESOLVE THE CAUSES OF UNEXPECTED REBOOTS, BLUESCREENS OR MISBEHAVING APPS
AWESOME NEW TECH REVIEWED
MSI'S LOUNGE ROOM FRIENDLY COMPACT GAMING PC
A PRO SSD FOR PEANUTS? SAMSUNG'S 960 EVO ON TEST
SEQUEL TO THE SMARTEST ROUTER WE'VE EVER TESTED
+ MORE INSIDE!
LABS TESTED

FREE DELIVERY TO YOUR HOME OR OFFICE EACH MONTH

HURRY

OFFER ENDS MAR 1ST, 2017!

TWO EASY WAYS TO SUBSCRIBE TO *APC* MAGAZINE

VISIT WWW.MAGSHOP.COM.AU/FUTURE **OR** CALL 13 61 16
AND QUOTE M1702APC

TERMS & CONDITIONS This offer expires March 1st, 2017, and is available to subscribers within Australia only. Please allow 6-8 weeks for delivery of your first issue. For full terms and conditions, see **www.magshop.com.au/future**. Please see our privacy policy on page 3. *Six issues for $45, then $45 charged to your credit or debit card every six issues thereafter on auto-renewal.

technotes

» NEED TO KNOW

Legal permission to disconnect

NEW FRENCH LAW MEANS WORKERS DON'T HAVE TO CHECK EMAIL AFTER HOURS.

In a bid to tackle burnouts and stress in an 'always-on' work culture, the French Government has passed a law that requires companies to negotiate clock-off times with staff, after which employees will have the right to ignore any work-related communication. If no such agreement can be reached, companies are required to publish a 'charter', explicitly outlining expectations and rights of the staff when they're off the clock. SS

White-hat hacker launches organisation to help vulnerable activists

FREE SECURITY HELP FOR DISSIDENTS.

Claudio Guarnieri, a Samaritan hacker and researcher at Citizen Lab, has launched Security Without Borders, an organisation aimed at providing cybersecurity to NGOs, activists, journalists and other at-risk groups. The organisation works as a free consultancy, offering their services in places where "security is no longer a privilege". There are currently 20–30 volunteers who donate their time. SS

Outsourced!

FACEBOOK GETS EXTERNAL HELP TO COMBAT FAKE NEWS.

After copping months of criticism, Facebook is releasing a suite of tools that will enable independent fact checkers to investigate news flagged as fake. Warnings from third-party organisations, viz., Snopes, FactCheck.org, Politifact, ABC News and AP will be added to flagged stories, which will appear lower in the news feed. It would also be impossible to promote these stories or turn them into ads, disrupting any financial incentive for spammers. SS

Pirate Bay and other torrent sites now blocked in Australia

No safe harbour for pirates.

In a move that's sure to make Australian pay TV and streaming services happy, the Federal Court has ruled that, as of January 9th, internet service providers are now required to block a number of popular copyright-infringing websites.The shortlist is comprised of The Pirate Bay, TorrentHound, IsoHunt, Torrentz and SolarMovie, the first four being targeted by pay TV powerhouse Foxtel and the last brought to the court's attention by Australian media company Village Roadshow.

The ISPs are tasked with taking "reasonable steps to disable access" to the offending sites, but the particular method of blocking isn't specified and the funding to do so will be coming from the rights holders. There will be a warning page for people who continue trying to visit these sites, however no penalty for doing so has been discussed. Regardless of how successful this particular blocking attempt may be, the ruling is a step towards an anti-piracy environment in Australia, with Foxtel chief-executive Peter Tonagh describing this judgement as a "major step in both directly combating piracy and educating the public that accessing content through these sites is not OK, in fact it is theft".

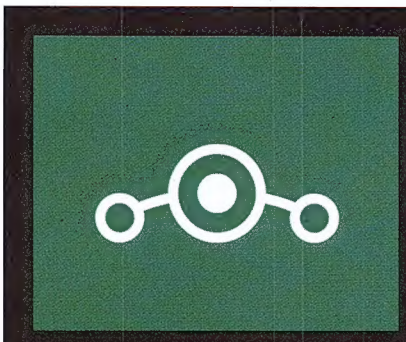
In some inconveniently adjacent news, staff at the popular Kickass Torrents site recently rebuilt and relaunched the site after it was brought down by US criminal investigations several months ago. **Harry Domanski**

The post-Cold War chill

AFTER ELECTION HACKING, US EXPELS 35 RUSSIAN DIPLOMATS.

In response to the alleged email hacking by Russia during the 2016 Presidential election, Barack Obama gave 35 Russian intelligence operatives 72 hours to leave the United States over the New Year period. He's even blocked Russia from accessing two compounds in New York and Maryland that were used for "intelligence-related purposes" by Russian personnel. Obama also placed sanctions on two Russian intelligence agencies — the GRU and the FSB. And in a bid to expose the Russians, the US has released a report of forensic evidence that links the cyberattacks to servers used by Russian intelligence services.

In retaliation, the Kremlin, which denounced the hacking allegations, recommended that Russia should expel 35 US diplomats from their country, stop US personnel from using a holiday home in western Moscow and bar access to a warehouse north of the city. But Vladimir Putin has refused to take any action, being hailed by President-elect Trump as being "very smart". **Sharmishta Sarkar**



Popular custom Android OS CyanogenMod suddenly killed off

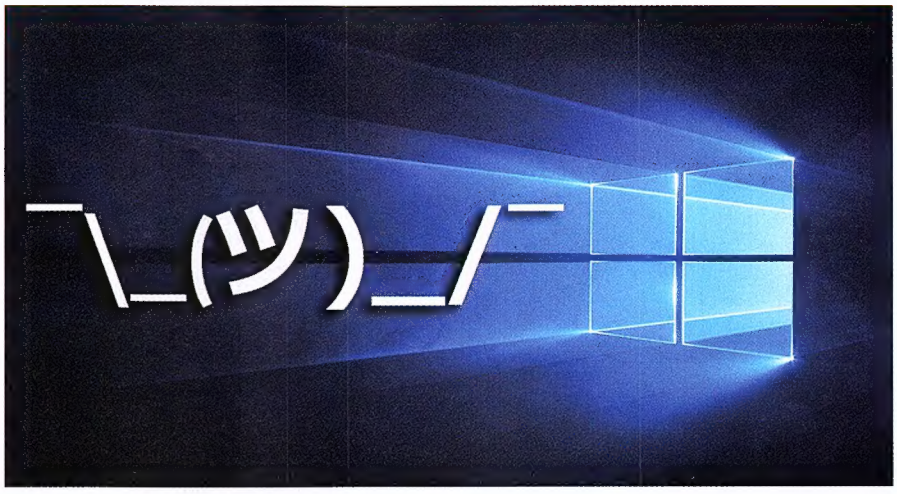
BUT SWIFTLY REBORN, WITH A NEW LIFE AND A NEW LOGO, AS LINEAGEOS.

There was some bittersweet news for lovers of the custom Android OS CyanogenMod late last year, as its parent company Cyanogen Inc. abruptly shut down. The upshot of this, however, is that by being open-sourced, the OS has been born anew under the LineageOS moniker. As this iteration of the veritable phoenix is still quite young, we're sure to expect some fixes and alterations in the coming weeks, but for now, you can follow its progress on **github.com/lineageos**. HD

Keep calm and save our images

PHOTOJOURNALISTS AND FILMMAKERS WANT CAMERA COMPANIES TO OFFER ENCRYPTION.

150 photojournalists and filmmakers have signed an open letter to the major camera manufacturers asking them to add encryption features to their products. Professionals usually transfer their images to an encrypted hard drive, but having the ability to protect images at the source, especially in dangerous parts of the world, would make accessing any footage when a device is grabbed virtually impossible, thus protecting the journalist or documentary filmmaker. SS



Microsoft admits Windows 10 upgrade push was too aggressive

Well, kind of...

To many users, Microsoft's promise of a free Windows 10 upgrade turned sour due to the company's use of aggressive and constant nag prompts — a move many still feel bitter about. So can a mea culpa help soothe any residual ill will?

The debacle played out over many months and saw Microsoft seemingly content to ignore complaints from thousands of users as they were inconvenienced in varying degrees. One woman landed a US$10,000 settlement after she sued the Redmond company when the update process crippled her office computers, while a member of an anti-poaching group in Africa took to Reddit in a rage after his pay-per-MB connection got hit with the 17GB update.

Along with some pointed security concerns from the community, the majority of complaints were aimed at the sneaky malware-esque approach that Microsoft took with its update prompts, with one particular example being a red 'X' in the corner of the window that, when clicked, didn't disregard the update as expected, but in fact scheduling it for later.

In early January, Microsoft's Chief Marketing Officer Chris Capossela mentioned on the Windows Weekly podcast that the aforementioned red-X incident was the "one particular moment ... that we had gone too far", although he also stated that he thought they "got it right" for a lot of the year and weren't "too aggressive". **Harry Domanski**

Valve fined $3M over refusing Steam refunds

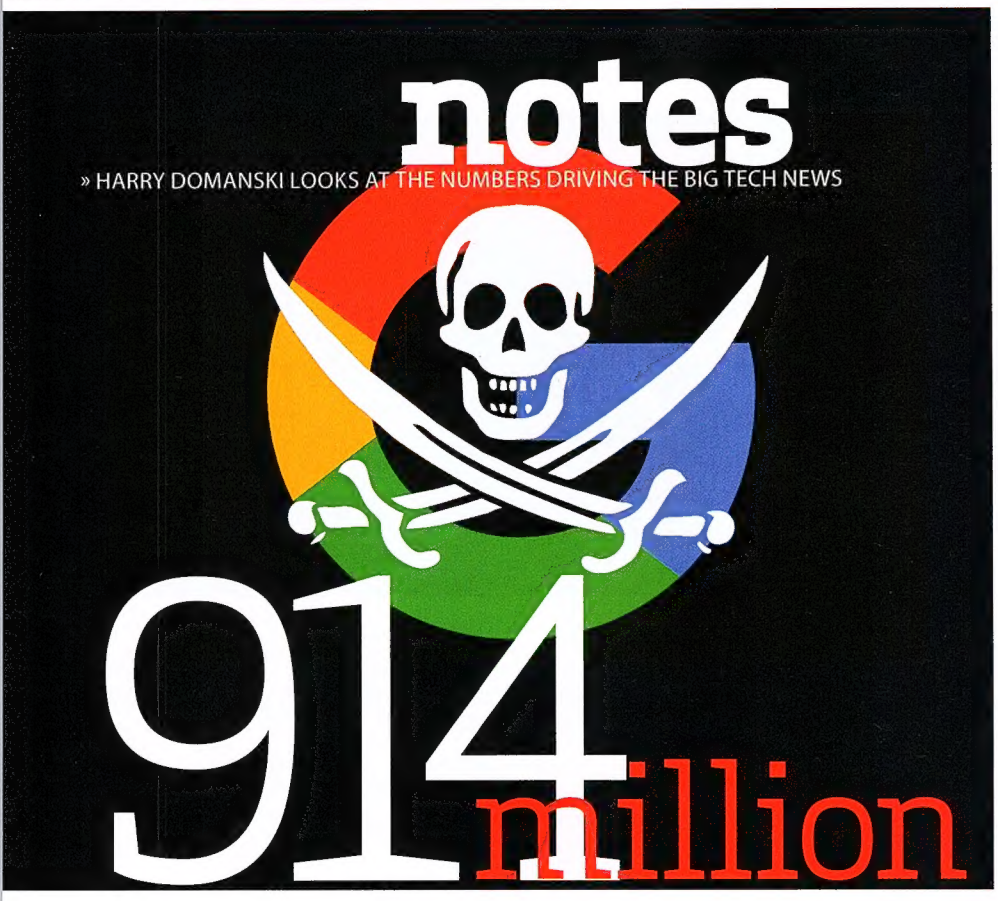
THE STEAM COMPANY FINDS ITSELF IN HOT WATER.

The Valve Corporation has been hit with a $3 million fine by the Federal Court after it was found that its Steam digital distribution platform had breached Australian consumer law with its anti-consumer refund policies. According to Valve's general counsel, Karl Quackenbush, the company didn't obtain legal advice or look into its obligations when it set up shop in Australia — it only started to do so once the Australian Competition and Consumer Commission voiced its concerns in April 2014. This excuse did not sit well with Justice James Edelman, who handed the company a penalty over a dozen times higher than the one suggested by Valve.

"[Valve] had a culture by which it formed a view without Australian legal advice that it was not subject to Australian law, and it was content to proceed to trade with Australian consumers without that advice and with the view that even if advice had been obtained that Valve was required to comply with Australian law the advice might have been ignored," stated Justice Edelman. **Stephen Lambrechts**

notes

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS



914 million

AMOUNT OF PIRATE LINKS REMOVED BY GOOGLE IN 2016.

Futile or not, Google has almost doubled last year's efforts in removing links that contain pirated content, pulling down close to a billion offending URLs spanning more than 350,000 sites. Around 90% of DMCA (Digital Millennium Copyright Act) takedown notices were successful based on 2016's stats, and Microsoft, HBO and Fox were among the companies throwing the most heat. Will this number continue rising, or will tightening piracy laws keep them in check? Only time will tell.

FIFTY

HOW MANY TIMES GOVERNMENTS AROUND THE WORLD SHUT DOWN THE INTERNET IN 2016.

We've had a tumultuous year in 2016, with the internet playing a big part in the mayhem. Whether it was to coerce democracy, silence the press or even stop students cheating, the internet has been taken down (or perhaps more accurately, access from various locales has been shut off) more than 50 times by various nations around the world in order to effectively blind the masses. The flipside is that, with the internet down, a country's economy will suffer — it's estimated India lost almost a billion dollars in 2015 due to this — so what did all this scheming truly achieve?

US$1.1M

AMOUNT A JAPANESE INSURANCE COMPANY HOPES TO SAVE PER YEAR BY REPLACING STAFF WITH AI.

Tokyo-based Fukoku Mutual Life Insurance has announced that it will be replacing 34 of its staff members — who are currently tasked with scanning documents and assessing claims to determine payouts — with a system based on IBM's Watson AI. This will not only save the company over one million US dollars each year, but will also bump up efficiency by around 30%, providing a much faster payout to the customer. The Japanese company already employs another IBM AI in order to check whether a call is an angry complaint or something more pleasant (unlikely as that may be).

1 PETABYTE

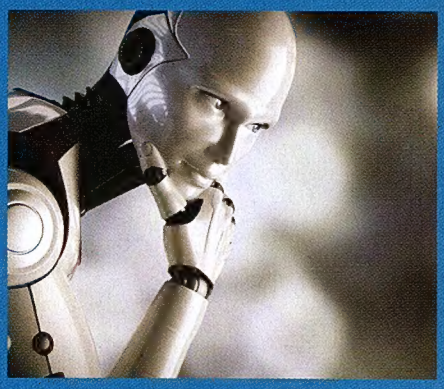
THE AMOUNT OF DATA THE ATO LOST DUE TO A HARD DRIVE CRASH.

Early in December, the Australian Taxation Office's website went down due to what it's called a "hardware issue". It turns out that issue was a major crash in their storage system (provided by Hewlett Packard Enterprise) that lead to the loss of around a petabyte of data — aka 1,000 terabytes. The issue wasn't helped when the backup systems failed to respond in time to the crash, but the ATO has moved to reassure everyone that no sensitive taxpayer data was compromised, and that this is a one-off, world-first issue.

US$27M

THE AMOUNT OF MONEY DEDICATED TO FUNDING RESEARCH INTO AI FOR THE PUBLIC INTEREST.

Offering up US$10 million each, LinkedIn co-founder Reid Hoffman and investment group Omidyar Network have kicked off funding for their newly-formed Ethics and Governance of Artificial Intelligence Fund, and have already gained an extra US$7 million in support. Alberto Ibargüen, president of one of these contributing foundations, says that "since even algorithms have parents, and those parents have values, [...] we want to influence the outcomes by ensuring ethical behaviour, and governance that includes the interests of the diverse communities that will be affected."



msi®

WORLD'S FIRST

7th GEN CPU GEFORCE GTX 10 SERIES REACH NEW HEIGHTS

BEST MEETS BEST
REACH NEW HEIGHTS

For more detail: MSI Australia & New Zealand Notebook

GE72VR / GE62VR Apache Pro

GAMING G SERIES

GEARED WITH LATEST
7th GEN. INTEL® CORE™ i7 PROCESSOR &
GEFORCE® GTX 10 SERIES GRAPHICS

7th GEN. INTEL® CORE™ i7 PROCESSOR	WINDOWS 10 HOME / WINDOWS 10 PRO
GEFORCE® GTX 1070 / 1060 / 1050 Ti GRAPHICS	VR READY	NAHIMIC VR
AL ALLOY CHASSIS DESIGN	120HZ / 5MS GAMING DISPLAY(optional)
COOLER BOOST 4	DYNAUDIO	FULL COLOR BACKLIT STEELSERIES KEYBOARD

INTEL INSIDE® . EXTRAORDINARY PERFORMANCE OUTSIDE.

intel CORE i7 7th Gen

WHERE TO BUY

NSW

Capitol Computer	(02) 9281 8890	http://www.capitolcomputer.com.au
Wireless 1	(02) 9687 8828	http://www.wireless1.com.au
Mwave	1300 727 446	http://www.mwave.com.au
Kong Computer	1300 159 272	http://www.kongcomputers.com
JW Computers	(02) 9726 2818	http://jw.com.au
Dcomp Online	(02) 4721 3457	http://www.dcomponline.com.au
Shopping Express	(02) 8338 8899	http://www.shoppingexpress.com.au
Digital Star	(02) 8748 6888	http://www.digitalstar.com.au
PC Byte	(02) 9723 0306	http://pcbyte.com.au

VIC

Tesc	(03) 9602 3499	http://www.tesc.com.au
Scorptec Computers	(03) 9249 6000	http://www.scorptec.com.au
PC Case Gear	(03) 9560 2122	http://www.pccasegear.com
PLE Computers	(08) 9309 4771	http://www.ple.com.au
Centrecom	(03) 8311 7600	http://www.centrecom.com.au
BCC Computers	(03) 5227 6888	http://www.bcccomputers.com.au/geelongwest
CPL	(03) 9223 4288	http://www.cplonline.com.au
Prototech	(03) 5444 1980	http://www.prototech.com.au
Umart	(07) 3369 3928	http://www.umart.com.au

NEW ZEALAND

JUSTLAPTOPS	(09) 442 2066	http://www.justlaptops.co.nz
Computer Lounge	(09) 368 4818	http://www.computerlounge.co.nz
Playtech	(09) 415 1020	http://www.playtech.co.nz

QLD

Umart	(07) 3369 3928	http://www.umart.com.au
Computer Function	(07) 3720 4777	http://www.computerfunction.com.au
Computer Alliance	(07) 3421 3200	http://www.computeralliance.com.au
GameDude Computers	(07) 3387 1500	http://www.gamedude.com

SA

Getright Computers	(08) 8231 0622	http://www.getright.com.au
IT Warehouse	(08) 8296 3211	http://www.itwarehouse.com.au
ALLNEEDS	(08) 8211 8461	http://www.allneeds.com.au

WA

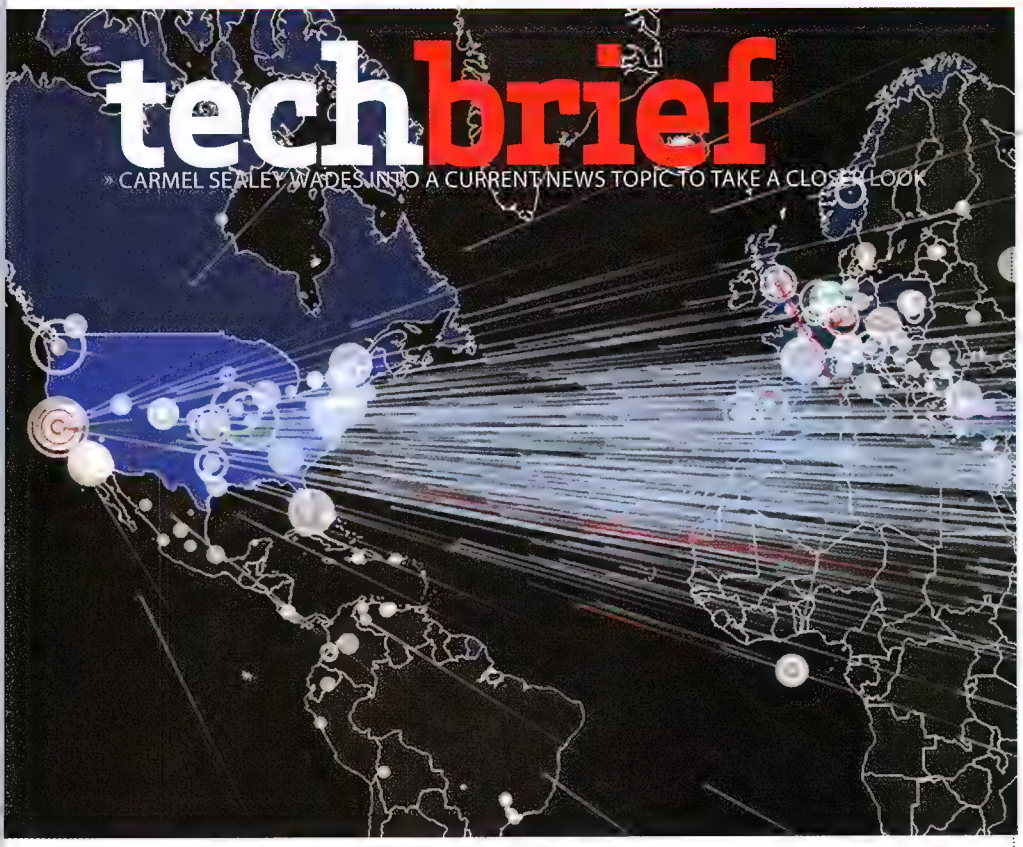
Affordable Laptops	(08) 9536 8500	http://www.affordablelaptops.com.au
PLE Computers	(08) 9309 4771	http://www.ple.com.au
Austin Computers	(08) 9202 0100	http://austin.net.au

ntel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of Intel Corporation in the U.S. and/or other countries.

COOL INNOVATION

techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK



The Internet of (really insecure) Things

DDoS, botnets and zombie armies, oh my!

In October 2016, a huge DDoS attack caused many popular websites – such as Google and Twitter – to crash. The culprit was a group of hackers who had taken control of thousands of Internet of Things devices, including web-connected cameras and DVRs, by the use of the now-infamous Mirai virus. This created a 'zombie' army of devices, known as a botnet, which was then used to send a multitude of fake web requests and overwhelm swathes of major sites online. There's obviously a sense of irony in this new problem, with many 'smart' devices proving vulnerable to attacks of this nature, and as IoT gadgets increase in popularity, this also increases the chance of future hacking events like the one seen last October. However, rather than simply pointing the finger at the manufacturers of such devices and blaming their lax security standards, the problem is actually worryingly bigger than that.

Netgear patches serious router security hole

PEDRO RIBEIRO, WHO DISCOVERED THE VULNERABILITY, SAID THAT IT COULD ALLOW A HACKER TO HIJACK THE DEVICE WITHOUT AUTHENTICATION.

While Netgear has stated that it is aware of the problem and that it only happens "in very limited instances", it has nevertheless announced plans to release firmware updates to patch the bugs. The router company attempted to reassure the public by explaining that the Remote Management advanced feature is turned off by default and that most users would not use it anyway. Very reassuring...

Oh, joy: now even our smart TVs can get ransomware

NOW SHOWING ON HBO — A FROZEN TV THAT DEMANDS PAYMENT BEFORE RETURNING FUNCTIONALITY.

As well as being able to spy on you by recording data and then sending it back to base (unencrypted, of course), smart TVs can also fall prey to hackers. Software engineer Darren Cauthon's LG TV was infected with a brand of Cyber.Police randsomware, which posts a locked image on the screen of a fake FBI letter, demanding repayment. Other users have also experienced similar troubles, a worrying sign that TVs aren't quite as safe as we'd like.

Smart lightbulbs can be hacked... by drone

INTERNET OF THINGS DEVICES INFECTED WITH A WORM VIRUS.

In November 2016, Researchers from the Institute of Science (Rehovot, Israel) and Dalhousie University (Halifax, Canada) produced a paper entitled 'IoT Goes Nuclear'. In the study, they demonstrate how easily Internet of Things devices — in this case, Philips Hue bulbs — can be hacked by infecting them with a "worm" that spreads from one to the next. After the bulbs were infected, the researchers controlled them via a drone hovering outside the building. It feels lighthearted at first, but then the study articulates the very real possibility of controlling a whole city's lighting via IoT hacks, and the risks of lazy security become immediately apparent.

Connected toys spark privacy concerns

THE INTERNET OF TOYS IS FAR FROM BEYOND SCRUTINY.

Genesis Toys, the brains behind My Friend Cayla and I-Que Intelligence Robot, and Nuance Communications, who provided the voice-recognition software for the two children's toys, have had complaints filed against them in multiple countries in Europe and also the US. The toys allegedly "record and collect the private conversations" of the young users and possess no "meaningful data protection standards" according to The Center for Digital Democracy in the US.

D-Link sued by US trade commission over lax webcam/router security

THE US FTC IS GETTING SERIOUS ABOUT INTERNET SECURITY.

The US Federal Trade Commission is taking a swipe at D-Link for what it says is the company's failure ensure its devices — and clients' private information — are secure. Some of D-Link's offences include the leaking of security keys in its routers and the inability for users to change default passwords in IP cameras, two flaws that hackers are known to utilise. This case also raises the question of which regulatory body should become responsible for the IoT industry in other suits going forward.

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit **www.ifixit.com**.

Razer OSVR HDK 2

Simple, easy to fix and an upgrade on the HDK 1.

An upgrade in resolution helps keep the screen density at an impressive 441 ppi.

The VR world is packed with serious contenders. The newest hardware and software solution comes from a dynamic duo: Razer, gaming peripherals giant, and Sensics, virtual reality maven. Their offering: the OSVR HDK 2. Can it hang with the platform heavyweights? We'll find out soon enough!

MAJOR TECH SPECS

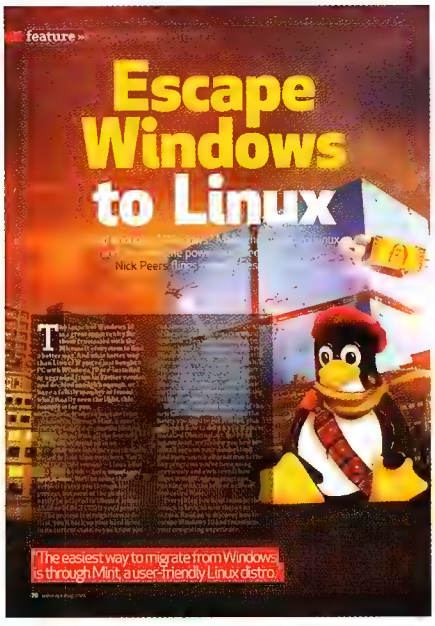
- Head-mounted display (HMD) with dual OLED displays, 2,160 x 1,200 combined resolution (441 ppi), 90Hz refresh rate
- IR camera with 360-degree tracking, operating at 100Hz
- Belt box with surround-sound audio codec, along with 'signal boosters'

KEY FINDINGS

- Time to hunt for those hidden IR LEDs. Because the HDK 2 is built to be accessible to developers, we aren't surprised to learn the headset's gatekeepers are friendly Phillips screws. But with the screws removed, the faceplate seems to be held in place by some mystical energy field (magnets).
- This motherboard's easy access is a teardown engineer's dream... Until we realise it's held hostage by two sneaky flex cables snaking down to the displays. Many components are accessible without having to remove the motherboard, so hopefully most users won't need to go this far.
- After removing four Phillips screws, the display assembly lifts out of the headset with ease. A smear of light adhesive attaches each of the screens to the plastic casing.
- Not all lenses are created equal. While the HTC Vive and Oculus Rift both offer adjustments for IPD (inter-pupillary distance), the OSVR does not. While the OSVR lacks IPD adjustment, it does boast one claim over the competition—those knobs allow independent eye relief adjustment. Anisometropia sufferers rejoice! Focus adjustments range from +4.5 to -2 diopters, which should allow most (but not all) regular optical-enhancers to ditch their spectacles while using the OSVR.
- **Repairability Score:** 9 out of 10 (10 is easiest to repair). Standard Phillips screws hold the headset and its components together. The motherboard is easily accessible after removing the cover. The cables and foam facepad are sturdy and detach easily. However, reconnecting the motherboard to the two display data cables underneath is tricky. The two OLED screens are attached to the case with adhesive that requires some prying to detach.

technotes

» EPINIONS


feature
Escape Windows to Linux
Nick Peers flings
"The easiest way to migrate from Windows is through Mint, a user-friendly Linux distro."

feature » escape windows to linux
Install apps in Mint
"You'll find the vast majority of Windows applications have an equivalent version for Linux."

ANOTHER VOTE FOR LINUX MINT

Congratulations. Your article on Linux Mint in the December 2016 issue of *APC* was excellent, Nick Peers has done an admirable job.

I've been using Linux as my primary OS since 'Warty Warthog' was a boy, and have switched to Mint in the last few years. I've helped out quite a few friends and customers with their PC issues and some have even switched to the "dark side"; however, I'm still amazed at the perceptions of a lot of people. Most range from "It's free, so it's rubbish", to "It's too nerdy and I don't understand it". However, once shown some basics, most are impressed – especially on older hardware.

I believe computers, first and foremost, are a tool – there's no 'one size fits all'. Everything has its place. Some need Windows, some will benefit immensely from switching to Linux, and those Apple people... I guess they're important, too. Even one of the major banks near where I live is using OS/2 (or they were up until a year or so ago when I last looked)!

Virtualisation is the key if you have enough underlying hardware and it's the way I've been running for years.

"I believe computers, first and foremost, are a tool — there's no 'one size fits all'. Everything has its place."

There are a few Windows applications that I find useful, so it makes perfect sense (primarily my share trading software, iTunes and TyreToTravel, as well as little things like firmware updaters for my Garmin GPS and Sena equipment).

The few systems that I've been able to set up this way for friends blows them away that they can have a "foot in both camps" *simultaneously* without dual booting. I have VMs containing multiple operating systems... great for tutoring others – and if I break one, then it takes 2 minutes to copy the broken VM from backup and it's ready to spin up again.

The various Linux distributions really have matured a lot, and when one stops to consider all the hardware in our lives that runs on some version of Linux, it truly is a useful operating system.

Craig Bailey

MAKING WINDOWS 10 USABLE

I just wanted to say thank you to the team for at least answering the reader with the Windows 95 security problem. I can imagine the reader to be an older man like me who works on the principle of 'If it ain't broke why fix it?'

Last year, at age 79, I was dragged kicking and screaming into the 21st century and away from Windows XP with a new laptop running Windows 10. With the help of articles in *APC*, I now feel that I have tamed it and made it behave as close to XP as possible. So thank you again.

P.S. To Darren Yates – we miss your informative video tutorials that came with the *PC User* mag disc, particularly your opening, "Ah, G'day, this is Darren Yates..."

Graham Dean

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Can fair use get a fair shake?

The Federal Government's Productivity Commission wants changes to Australian copyright laws, but content owners are baulking. Shaun Prescott investigates.

While many of us have been using the internet to access information online for 20 years or more, in many areas, it seems like media industries and lawmakers are still playing catch up.

The 'rise' of the digital age is still 'rising', in other words, but some recent recommendations by the Productivity Commission oriented around the concept of fair use could make accessing material online a little less fraught with legal danger – if the proposed amendments become a reality.

The most interesting proposal is related to the use of VPNs – popular among people who prefer to use the US version of Netflix, or for those not wanting to be hit with the so-called 'Australia Tax' on consumer goods. According to a lawyer speaking to Techly.com, those who use a VPN to stream content – even if they're paying for it – could potentially face over ten grand in fines under Australia's current law. One of the Productivity Commission's recommendations is to make it explicitly legal to access lawful content via VPN.

The law is complicated, but people will generally know whether something is illegal or not, just on a hunch. Clearly, that isn't the case when it comes to fair use of intellectual property online, and this recommendation is just one of several suggestions being flagged. Another suggests relaxing laws in order to bring them up to speed with fair use laws in the United States – i.e. better explaining and expanding what it is and what it determines. In an online environment full of embeds, cross-linking and enthusiast archiving of long dormant and un-monetised IP, it's about time these matters were re-addressed.

No, we're not quite sure what's going on in this picture either.

The recommendations, issued in late December, have raised the ire of at least three organisations, including the Copyright Agency and APRA AMCOS. Any expansion to user rights presents a threat to the potential revenue made by creative industries, and organisations like APRA – designed to facilitate and protect the music industry's income – are keenly aware that the industry is already on the back foot, and has been for many years. According to APRA's CEO Brett Cottie, some of the proposals are "singularly aimed at weakening Australia's existing copyright regime – the economic framework around which Australia's creative industries are built."

Still, the Productivity Commission's report claims that the country's "copyright arrangements are skewed too far in favour of copyright owners to the detriment of consumers and intermediate users". Elsewhere, it states that "Australia's [existing fair use] exceptions are too narrow and prescriptive, do not reflect the way people today consume and use content, and do not readily accommodate new legitimate uses of copyright material."

It's a complicated topic, and while many are likely to root for the cause of the consumer – we're all one, after all – it's worth remembering that copyright is often about protecting creator's work, rather than inhibiting the users. ■

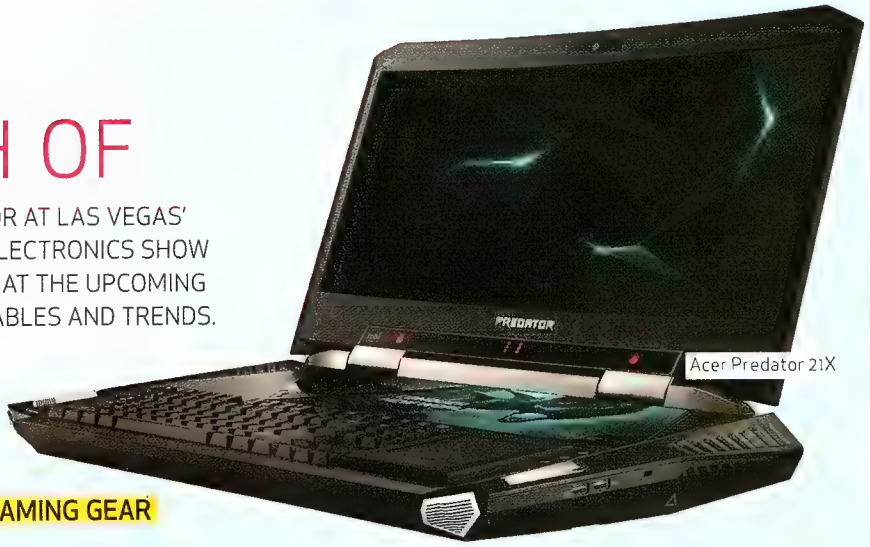
END USER

Share your stories!

If you have an iteresting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

HOTTEST TECH OF CES 2017

WE ROAMED THE FLOOR AT LAS VEGAS' ANNUAL CONSUMER ELECTRONICS SHOW TO GET A SNEAK PEAK AT THE UPCOMING GADGETS, PCS, WEARABLES AND TRENDS.



Acer Predator 21X

PC GAMING GEAR

ACER PREDATOR 21 X

US$8,999 | AVAILABLE FEBRUARY IN THE US; AU TBC

In what could only be seen as a show of force from Acer, it has announced the Predator 21 X gaming laptop. It comes with a 21-inch 1080p curved screen (a world first for laptops apparently), two GTX 1080 graphics cards, four 512GB SSD drives and 64GB of memory. Aside from the sheer grunt under the hood, it has premium features like a mechanical keyboard and built-in eye tracking, as well as four speakers and two subwoofers. As with some of the other excessive gaming laptops we've reviewed over the last six months, it also requires two power supplies to run at full tilt.

RAZER PROJECT VALERIE

PRICING AND AVAILABILITY TBC

Although still a prototype and lacking concrete specs, Razer's bold Project Valerie has one (or three) glaring feature(s). It is essentially a 17.3-inch Razer Blade Pro laptop, but instead of a single 4K display, this thing has three — the other two able to automatically slide out from behind the main display on sets of rails. Despite Razer having a history of its concepts not making it to market (such as last year's 'Project Christine' modular desktop), Valerie was playable at CES 2017 and reportedly ran *Battlefield 1* like a dream, albeit with a lot of noise.

TPCAST FOR HTC VIVE

AVAILABLE Q2 2017 | US$249

HTC's Vive is trying to go wireless, and we've known this for a while as the TPCast has been available for pre-order since November 11th, but now the unit has an official price and release date. This adapter should let Vive owners go wire-free for about 90–120 minutes on the standard battery (although an extended 5-hour battery is available), and consists of both a transmitter and receiver, which is how it delivers HD content wirelessly to the headset.

RAZER PROJECT ARIANA

PRICING AND AVAILABILITY TBC

Ariana was another concept-stage prototype from Razer, again focusing on broadening your gaming display, but this time with a projector. Project Ariana will use a fish-eye lens to project your game's display as well as its periphery, better mimicking the natural view of the human eye. It uses 3D cameras to warp the display so it will appear

Razer Project Ariana

AMAZON INVADES THE SMART HOME WITH ALEXA

Amazon wasn't at CES this year, but its presence was felt. From dishwashers to security systems, even cars, Alexa has been unleashed. Westinghouse, Element and Seiki are set to launch TVs with the Fire TV software installed and an Alexa voice-controlled remote; LG's added Alexa to a fridge and its robot companion 'Hub'; there are portable speakers and charging docks with Alexa support; and Whirpool's latest range of home appliances can be controlled (to some degree) with Alexa. You could even light and heat your home via Alexa. Plus, Ford wants to make Alexa a driver assistant.

TPCast
for HTC VIVE

flat no matter what obstacles lie in its way and incorporates Razer's Chroma lighting for further visual synchronicity. It may seem a bit niche, but Ariana will thankfully also function as a regular 4K projector.

ASUS VIVOPC X

US$799 | AVAILABLE MARCH IN THE US; AU TBC

The compact VivoPC X looks to be a VR powerhouse for the lounge room, managing to stuff a 7th-gen Intel Core i5 processor and a GTX 10-series Nvidia GeForce graphics into a 5-litre chassis. This console-esque desktop is aimed at users looking for a PC that can handle the hardware demands of burgeoning VR tech and, as such, is compatible with all the latest VR headsets and sports four USB 3.1 and two USB 2.0 ports for plugging in the relevant peripherals.

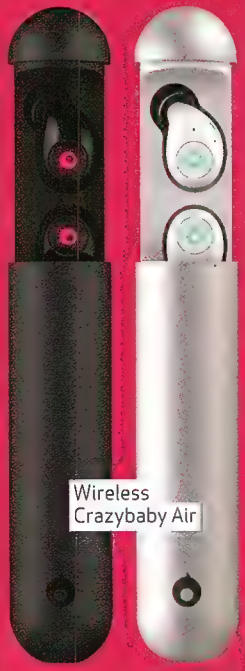
ACER PREDATOR Z301CT

US$899 | AVAILABLE FEBRUARY IN THE US; AU TBC

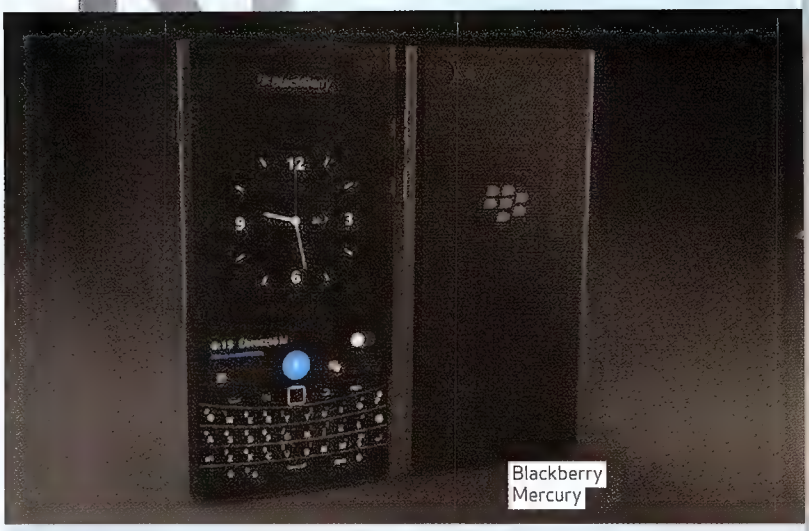
Acer's 30-inch Predator Z301CT is pitched as "the world's first 21:9 curved monitor with eye-tracking functionality". Along with a 2,560 x 1,080-pixel resolution, the VA panel itself features Nvidia's G-Sync variable-refresh tech and a rate that tops out at 200Hz. The eye-tracking bit comes in via Tobii, a technology which lets you do things in games just by moving your eyes (and is starting to become more useful as the list of supported titles grow), and it also features Acer's ErgoStand which offers plenty of adjustability in positioning for some supreme comfort.

GET USED TO AIRPOD-STYLE 'TRULY' WIRELESS EARPHONES

Truly wireless earphones (i.e. earphones that don't even have a wire connecting one ear to another), have technically been around for over a year, and have been fantasised over long before that. With the recent release of Apple's own Airpods, it's no surprise to see a few hopeful entries into the category at this year's CES. Some, such as the Bodytrak, offer the full "hearable" experience, which integrates smart 'wearable'-style technology like biometric monitoring of multiple vital signs. Affordable options geared more toward pure listening pleasure, often with a fitness slant, were much more prevalent at the summit than the smarter hearable tech — a lot of these are being offered around the same $250–350 price point, hinting at a more consumer-friendly environment for our 'truly wireless' future.



Wireless
Crazybaby Air



Blackberry
Mercury

SMARTPHONES

HUAWEI HONOR MAGIC

PRICING AND AVAILABILITY TBA

This new Android smartphone might only be available in China (at least for now), but it's been the talk of the town at Las Vegas this year. It boasts a curved AMOLED display, an octacore processor, 4GB RAM and 64GB of internal storage. But that's not what makes this a standout. The front camera uses facial recognition technology to unlock the screen and locks it when you look away, displaying lockscreen notifications only for pre-registered faces. Now, that's magic.

CHANGHONG H2

PRICING AND AVAILABILITY TBA

For fans of *Star Trek*, the tricorder is just a phone away. The Changhong H2 is a smartphone with a built-in near-infrared spectrometer — technology that shines a light on an object and analyses the unique optical signature of the object. With this tech in the palm of your hand, you can measure body fat, scan nutritional content of food and drink, even detect authenticity of products. This technology even has the power to detect cancers.

BLACKBERRY MERCURY

PRICING AND AVAILABILITY TBA

There's a new BlackBerry coming in 2017. This as-yet-unnamed phone, dubbed 'BlackBerry Mercury', will be unveiled at the next Mobile World Congress. But what we do know is that it will run Android Nougat and the familiar QWERTY keyboard will still be there, with the ability to scroll through pages by gliding your fingers over the keys. What's new is the fingerprint sensor neatly tucked into the keyboard's space bar.

ASUS ZENFONE AR

PRICING TBC | AVAILABLE FROM JUNE IN US; AU TBC

The amazing specsheet for the ZenFone AR includes a 5.7-inch 2,560 x 1,440 Super AMOLED display, 8GB of RAM, a 23MP motion-and-depth tracking camera system and powerful Snapdragon 821 guts. It's the first phone to run both Google Tango and Google Daydream experiences, making it one of the most futureproof smartphones to hit the market. The ZenFone AR also boasts a Super Resolution in its camera setup that ASUS claims can capture four photos shot, then stitched into a single 92MP image.

ASUS ZenFone AR

LAPTOPS, PCS & 2-IN-1S

Dell XPS 13 2-in-1

HP ENVY CURVED ALL-IN-ONE (34-INCH)

FROM US$1,729
AVAILABLE NOW IN US; AU TBC

There's something quite satisfying about all-in-one computers, and the new HP Envy with a 34-inch curved screen is looking to be a particularly sleek addition to the field. With an elegant flat dock, featuring integrated B&O speakers and a neat radial dial for volume, the Envy seems to land between entertainment centre and PC. The specs will vary, with 7th-gen i5 or i7 processors, up to 2TB HDD storage and other optionals like wireless charging.

DELL XPS 13 2-IN-1

FROM $2,299 | AVAILABLE NOW

For the past few years at CES, we've looked to Dell's XPS 13 as one of the darlings of the show, now they've finally taken the next logical step and gone hybrid. The XPS 13 2-in-1 comes in a few different flavours with the top-tier option sporting QHD+ (3,200 x 1,800), 16GB memory and 1TB of SSD storage. Much of the design is carried over from its predecessor, with the welcome addition of sturdy steel hinges and the nearly bezel-free InfinityEdge screen.

ASUSPRO B9440 & LG GRAM 14

ASUS, US$1,000; LG, TBC | ASUS AVAILABLE MID-2017 IN US (AU TBC); LG TBA

ASUS and LG have each coughed up new 'lightest in class' 14-inch notebooks, and while they both hover around the 1kg mark, the ASUSPro B9440 technically loses out to the LG Gram 14 by around 80 grams. The ASUS comes in a sleek magnesium alloy frame and sports an impressive Full HD, 14-inch screen, given its small 13-inch form factor; however, it is not a touchscreen. The design is quite striking, and as you open the lid of the laptop, an extended section of the lid acts to lift the keyboard, giving it stylish and ergonomic tilt. The LG is actually an improved version of an existing notebook, this time claiming a huge 24-hour battery life (albeit, using decade-old, unreliable benchmarks), as well as Full HD, IPS touchscreen. The Gram's pricing and availability are yet to be announced so it's difficult to comment on value; however, we do know that it will ship in 13-, 14- and 15-inch varieties and offer a range of internal specs.

Samsung Chromebook Pro

SAMSUNG CHROMEBOOK PRO AND PLUS

PRICING AND AVAILABILITY TBA (NOT YET CONFIRMED FOR AU)

While we can't expect these to arrive in Australia, the progression of Google's laptop OS is worth following. Samsung has added two new near-identical entries into the Chromebook series, the Pro and the Plus only differing in processor and price (one with an Intel M3, and the cheaper with an ARM processor). At a glance, both have a 2,400 x 1,600-pixel resolution (supporting 4K streaming), Gorilla Glass, two USB-C ports, 4GB of RAM, 8-hour battery life and weigh less than 1kg.

LENOVO MIIX 720 2-IN-1

$1,399 | AVAILABLE MID-2017

The Lenovo Miix 720 seems to have Microsoft's Surface Pro 2-in-1 squarely in its sights. With a 12-inch QHD+ touchscreen (or 2,880 x 1,920-pixels), up to a 7th-gen Core i7 processor and 16GB of memory, the Miix is plenty powerful. Like the Surface Pro, it can seamlessly morph from notebook to tablet; however, the Lenovo comes bundled with its keyboard and an Active Pen 2 stylus capable of 4,096 levels of pressure sensitivity (four times that of the Surface).

INTEL 7TH-GEN NUCS

PRICING TBA | AVAILABLE Q1 2017

Intel's Next Unit of Computing (NUC) palm-top PCs have a bold title, and the latest iteration — featuring Intel's 7th-gen Core (aka 'Kaby Lake') processors — is hoping to steer closer towards that lofty claim. Two smaller, and three slightly larger units are available with a variety of specs and connectivity across the range. The top model will have an i7 processor, a pair of DDR4 memory slots, four USB 3.0 ports, a HDMI 2.0 port, and support for Intel's Optane storage technology (see opposite, far right).

MESH WI-FI NETWORKING GOES MAINSTREAM

Mesh Wi-Fi networks could become the norm for homes and offices. Mesh Networking uses a system of nodes that intelligently communicate with each other wirelessly in order to transmit the signal with minimal loss from one node to another. The parent node is the only device that needs to be physically connected to the network source, essentially creating a 'cloud' of connectivity that expands with the amount of slave nodes introduced. The Linksys Velop system allows each of its nodes to act as a router, range extender, access point and bridge, and claims to dynamically adjust itself for optimal speed. ASUS's Hive offering is rather similar although with two tiers of product, the HiveSpot and slightly toned-down HiveDot, both tiers being able to create a mesh network of 3–5 nodes using its AiRadar beamforming tech.

AMD Ryzen desktop CPU

TECHNOLOGIES

AMD RYZEN CPUS & VEGA GPUS
PRICING TBA | AVAILABLE FIRST HALF 2017

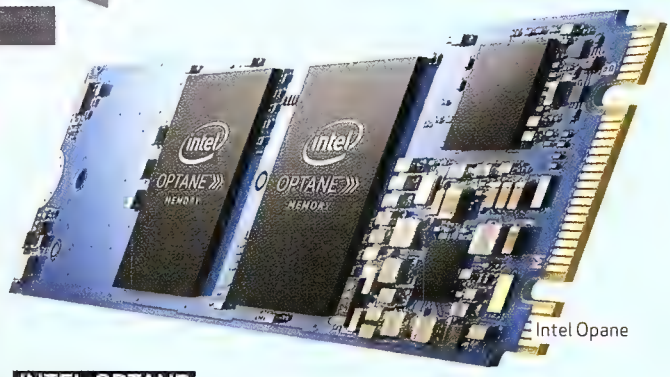
AMD's finally taken the wraps off its anticipated Zen desktop CPUs, which'll officially be known by the name 'Ryzen' when they hit the market in the next 3–4 months. The range is being headlined by an 8-core, 16-thread model with clock speeds of over 3.4GHz, and all the new processors will require a matching new AM4-chipset motherboard. Ryzen and AM4 are being positioned as AMD's high-end offering that's designed to go up against Intel's X99 platform — and it's anticipated that they'll do so at a much more wallet-friendly price.

Alongside the new CPUs and motherboards, AMD also used CES to talk up its new Vega GPU set, which it's hoping will tackle Nvidia's higher-end 10-series GeForce cards. Moreover, when Ryzen and Vega combine, they reportedly run like a dream, getting *DOOM* on Ultra settings to run at 4K resolution at just under 70fps in a booth at CES — or about 10% faster than a top-shelf Intel/Nvidia combo.

So can AMD finally rise up and take on its old rivals' best offerings with this new dynamic duo? We'll find out later this year.

QUALCOMM SNAPDRAGON 835
AVAILABILITY TBA

Qualcomm has adopted a new method of chip fabrication for the Snapdragon 835, the 10-nanometer process, promising to bring future-ready processing power to your smartphone. The chip is smaller and more efficient with battery life than the previous iteration, and has eight cores rather than four. Qualcomm has also partnered with a smart glasses manufacturer, ODG, suggesting a future outside of smartphones. Although leaked documents suggest it will be available in Q1 of 2017, and may even power the Galaxy S8, nothing official has been said on this matter.



Intel Opane

INTEL OPTANE
PRICING TBC | AVAILABLE Q2 2017

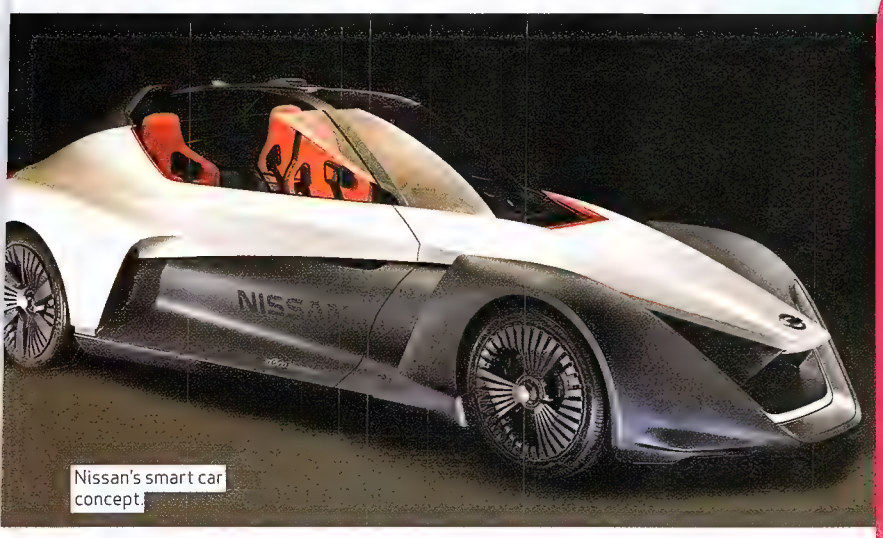
In partnership with Micron, Intel has developed what it's calling 3D Xpoint memory — aka 'Optane' — a caching technology which, when coupled with a hard disk drive, the chip-maker is promising will provide "SSD-like speed while maintaining large-storage capacity". While the available 16GB and 32GB sizes aren't necessarily all that 'large', hopefully this tech will lead to the ability to increase storage size without sacrificing speed. Optane uses the M.2 socket format and requires a compatible system, which currently means a platform based on either Intel's 7th-gen Core i (Kaby Lake) or Xeon E3 v6 processors.

AMD FREESYNC 2
AVAILABLE FIRST HALF OF 2017

The first iteration of FreeSync aimed to adaptively synchronise the refresh rate of your monitor so that it matched the frames-per-second being output by your graphics card, ultimately resulting in a smoother gaming experience. FreeSync 2 promises to refine this by improving low frame-rate performance, reducing latency and most importantly, bringing variable refresh rates to HDR displays. Displays equipped with FreeSync 2 may not be cheap due to these requirements, and AMD has to make some hardware friends to do so, with Samsung already confirming it's buddied up.

INTEL COMPUTE CARD
PRICING TBC | AVAILABLE MID-2017

The Compute Card is an apt name for Intel's new device, which is essentially a bona fide computer in an enclosure that's about the shape and size of a credit card. The aim of this product is that it'll plug into smart devices in order to upgrade them with more current capabilities. The range of cards are expected to come with a variety of specifications and to continue releasing more powerful iterations, meaning, for example, that you could keep your smart TV up to date without buying a whole new unit.


Nissan's smart car concept.

SMART CARS BEING ADOPTED BY SMART AUTO-MAKERS

Smart cars are slowly shifting from the realm of futuristic concept to likely reality, and new introductions in the field from several major mainstream car manufacturers have fortified this shift. Although some of the concepts involve technology such as electric motors and self-driving, the one feature they all seem to share is their integration with AI. Nissan and BMW have both partnered up with Microsoft to integrate Cortana into the dashboards of certain future models, and Nissan also will use Microsoft-powered AI to predict when a transmission failure may occur. Amazon's Alexa will be hopping into a Ford, and Hyundai will be joined by Google Assistant in a similar voice-activated capacity. Toyota's Concept-i stands out, though, with its own digital assistant, Yui, claiming to enhance the relationship between car and driver.

CES's BIZARREST TECH ON SHOW

NESTLED AMONG THE BIG-NAME STANDS AND 'NEXT BEST THINGS' AT LAS VEGAS' ANNUAL TECH CONVENTION, YOU'LL ALWAYS FIND A WIDE SELECTION OF MORE OFFBEAT PRODUCTS.

Make love on a beech in France with the LoveBox.

CES is a great place for finding the weird-and-wonderful – things that nobody every really asked for and that are often, well, unconventional to say the least. Here, we've put together just a small selection of some of our favourite bizarre products from this year's show floor.

SPACE-AGED HAIR CARE

Saving your crowning glory may not be top priority, but it's a vanity we're all guilty of. But who knew we needed a dedicated device to tell us how to improve brushing our hair? L'Oreal, Withings and Kérastase have, together, developed a 'smart brush' that houses a mic and moisture sensors so it can detect how dry and susceptible to breakage your hair is, and even offer advice on your brushing style.

Alternatively, if there's not that much left that actually needs brushing, the makers of the iGrowth claim that this helmet, which uses 51 lasers and LED lights, can make your mange mane thicker and more luxuriant. It even has built-in headphones so you can enjoy a gaming session while doing your hair. If a helmet sounds too claustrophobic, the HairMax Laser Band 41 says it'll do much the same thing, but has its 41 lasers instead installed onto a thick hair band.

A TOOTHBRUSH THAT TALKS BACK

The Ara is clearly no ordinary mouth scrubber. Deep-learning algorithms embedded in the toothbrush are set to make the dentist's chair obsolete. Data from sensors in the brush run through a low-power processor, enabling the system to learn your habits and refine your brushing technique. And here we are using boring bristles.

MY SHORTS ARE VIBRATING

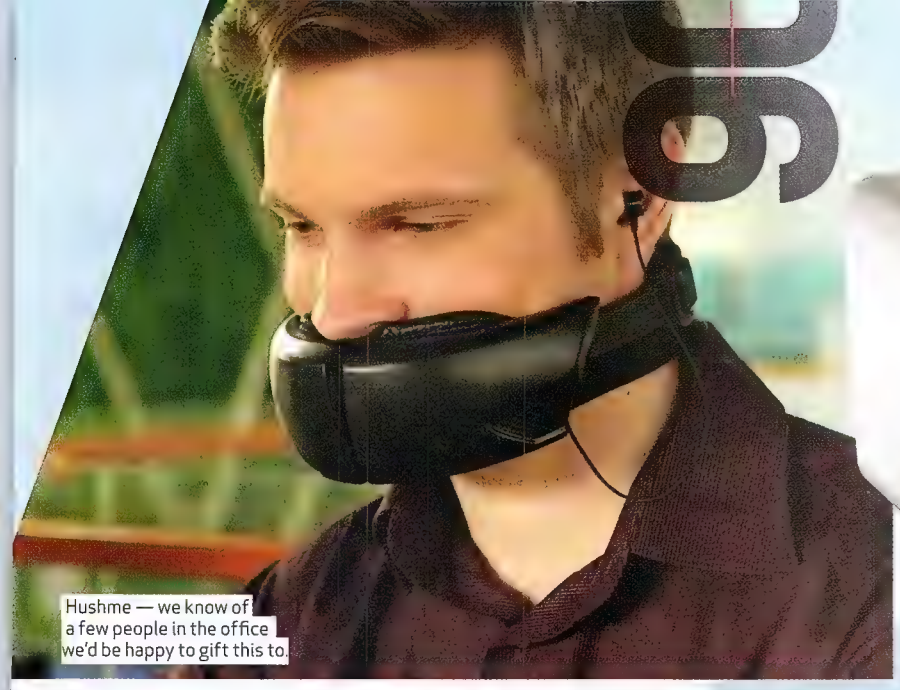
What's hotter than hotpants? Well, vibrating ones, of course. The Spinali Design shorts have vibrating sensors on the belt, which connect to the wearer's smartphone via Bluetooth, helping them to navigate busy city streets by buzzing when they need to make a turn. The sensors even buzz for an incoming calls and texts — all things a smartwatch on your wrist would accomplish just as well, come to think of it...

THE LOVEBOX IS LESS SMUTTY THAN IT SOUNDS

This could be one of the more whimsical gadgets on display at CES — a wooden box touted as the most romantic connected object of all time. Crafted from beech wood in the French village of Saint-Amour, the LoveBox displays messages on a mirrored digital screen sent from a compatible smartphone app. And to notify users of unread messages, a heart on the side of the box spins, stopping only when the messages have been read.

DockATot Deluxe: perfect for prodding toddlers to make sure they're OK. Apparently.

Addicted to bass? The Lofelt Basslet might be your jam.



Hushme — we know of a few people in the office we'd be happy to gift this to.

Griffin Technology's Connected Toaster can help you make toast, strangely enough.

"The makers of the iGrowth claim that this helmet, which uses 51 lasers and LED lights, can make your mange mane thicker and more luxuriant."

CAN'T EVEN MAKE TOAST? HAVE WE GOT THE APPLIANCE FOR YOU...

The simplest appliance in your kitchen just got an upgrade — its days of burning your bread are over. Griffin Technology's Connected Toaster depends on digitally-controlled heating elements allowing users to set a precise temperature and toasting time. And just in case you forgot what your favourite toasting preferences are, a Bluetooth connection to a free smartphone app will take care of that.

BETTER THAN A STICK, WE SUPPOSE

CES has it's fair share of oddities every year and this year is no different, with this strangely named connected mini crib. In a bid to transform the way babies sleep, the DockATot Deluxe is touted as a multifunctional dock where the tots can lounge, play, snuggle and rest. But what's a little ominous about this piece of smart furniture is its ability to poke a baby if the crib doesn't detect a heartbeat for more than 12 seconds.

The smart hair brush — because you're worth it?

SPEAK IN SILENCE (WHILE LOOKING LIKE A SUPERVILLAIN)

Ever tempted to get a muzzle for colleagues that constantly chatter away on the phone or to each other? Well, there's an almost-Bane-like mask that could be their next Secret Santa gift. The Hushme is a voice mask attached to a pair of Bluetooth earbuds. The mask snaps shut in front of the mouth thanks to strong magnets, but allow calls to be made with conversations shielded, either by muffling or by adding sounds to drown out the speech.

IS THERE SUCH A THING AS 'TOO LITTLE BASS?

It's the age of the wearable, so why should your thumping beats be left behind while you're out and about? Now you can snap on this one-of-a-kind watch-size subwoofer onto your wrist — and it's pretty much compatible with any audio device that has a traditional 3.5mm audio-out jack. The Basslet, from German startup Lofelt, is a black box that's... well, just that. Simply plug a dongle into the audio jack of your phone or music player for headphones, play some tunes and the Basslet will gently thump away on your wrist.

JUST STICK THIS SPIKY THING ON YOUR FACE

Samsung has decided to bring to light the nitty-gritty details of our skin's condition with a handheld device. The S Skin will project light on your skin, the reflection of which will be analysed by inbuilt sensors. Metal contacts on the device can simultaneously determine your skin's moisture level to measure conductivity. This data will then be fed into a smartphone app to provide you with a customised beauty regime. The package will even include micro-needle nutrient patches to keep your skin looking younger.

NOT QUITE AS EXCITING AS BEER GOOGLES, BUT CLOSE

Ever wish you had something to tell you when to call it a night before you toppled into a puddle of vomit? The BACTrack Skyn is the world's first wearable that has the potential to provide a detailed assessment on how our bodies handle drinks. It measures a person's transdermal alcohol content (TAC) in near real-time without needing to blow into a device, saving you from some rather embarrassing moments. ■

PC

$1,799 | AU.MSI.COM

MSI Trident 3

Is it getting hot in here?

LABS BENCHMARK RESULTS

General system performance

PCMARK 8	HOME (ACCELERATED)
MSI TRIDENT 3 VR7RC-055	4893
ALIENWARE ALPHA (2016)	4393

0 1000 2000 3000 4000 5000

Disk performance

CRYSTAL DISKMARK 5	SEQUENTIAL READ
MSI TRIDENT 3 VR7RC-055	559
ALIENWARE ALPHA (2016)	1543

0 500 1000 1500 2000 2500

CRYSTAL DISKMARK 5	SEQUENTIAL WRITE
MSI TRIDENT 3 VR7RC-055	338
ALIENWARE ALPHA (2016)	311

0 100 200 300 400 500

General performance

CINEBENCH R15	CPU (MULTI-THREADED)
MSI TRIDENT 3 VR7RC-055	849
ALIENWARE ALPHA (2016)	650

0 200 400 600 800 1000

Gaming performance

METRO: LAST NIGHT	1080P, VERY HIGH (AVG FPS)
MSI TRIDENT 3 VR7RC-055	74
ALIENWARE ALPHA (2016)	50.67

0 20 40 60 80 100

Thermal performance

VITALS	PEAK CPU TEMPERATURE
MSI TRIDENT 3 VR7RC-055	100°C
ALIENWARE ALPHA (2016)	66°C

0 20° 40° 60° 80° 100°

No bigger than a PS4 Pro or Xbox One, MSI's lounge room friendly Trident 3 is one of the most svelte mini gaming PCs we've ever tested. Its compact parallelogram-shaped chassis means it'll easily fit on a shelf in your TV cabinet, but the included stand (which is less stable than we would have liked) gives you the option of flying it vertically as a tower.

Spearheading the Trident 3's list of specs is a 7th-gen Intel Core i7-7700 CPU, although that's running on a slightly older 6th-gen entry-level H110 chipset-based motherboard. This slightly Frankensteinian component arrangement will mean that some of the additional features and upgrades offered by that newer i7 chip will be unavailable.

Adding fuel to this fire, the CPU cooler doesn't seem up to effectively cooling that CPU, maxing out HWMonitor's temperature gauges with readings of 100°C, even when only under partial CPU load. These temps sit at the upper limit of what CPUs can handle — the result is that the CPU will automatically be throttled down to try to let that excess heat dissipate. In the long run, CPUs regularly operating at the top of their temperature range can suffer from decrease lifespan and, moreover, the heat they put out can even damage surrounding components.

If you can look past that (somewhat perplexing) flaw, there's a lot to like about the Trident 3. Leveraging the performance and efficiency boosts of Nvidia's latest Pascal GPU architecture, the Trident 3 is fitted with a VR-ready GeForce GTX 1060. This GPU is supported by a slightly low but acceptable 8GB of RAM, a 256GB SATA-3 SSD and a 1TB HDD, so its raw processing-power easily puts Microsoft and Microsoft's current gaming consoles to shame. The cutting edge components of the Trident 3 are even a generation ahead of Dell's $1,500 Alienware Alpha.

In testing, the Trident 3 easily dominated the Alpha and its GTX 960 GPU across older titles on 1080p Ultra settings, churning out 133, 114 and 87.5 frames per second across our *Tomb Raider*, *GRID 2* and *Bioshock Infinite* benchmarks, respectively, compared to the latter's 84, 87 and 70 respective fps scores.

The Trident 3's CPU managed to pin benchmark scores of 19.9 and 849 on the CPU-focused HWBOT x265 1080p media encoding and Cinebench R15 multi-threaded CPU benchmarks. The Trident 3's scores are reflective of some CPU throttling, when compared against the scores of the Alpha's core i7-6700T CPU scores of 14.5 and 650 on the same tests, but the end result was pretty negligible.

If that CPU didn't get quite so hot, we'd already be mentally rearranging our own TV-cabinet to fit in this $1,799 unit (which includes an accompanying Stratus XL controller and *For Honour* game code). But the potential long term consequences of that hot-running CPU are enough to make us reconsider — and wishing for a slightly cooler-running Core i5 version. ■ **Joel Burgess**

Verdict

Features	★★★½☆
Performance	★★★★☆
Value	★★★½☆

A living room PC that offers plenty of performance at a fair price, but that hot-running CPU is a definite concern.

★★★½☆

NAS

$390 | WWW.SYNOLOGY.COM

Synology RT2600ac

What would you get if a router and a NAS had a baby?

Despite no lack of attempts, relatively few outsiders have been able to break into the broadband router market – a space that, for the last decade, has largely dominated by big players like Netgear, Linksys, D-Link and TP-Link.

Synology has been fighting a bit of an uphill battle since it introduced its first router, the RT1900ac, last year – but it's one that's at least partially fuelled by the good will flowing on from its well-recieved and feature-packed NAS boxes. The company's now followed up that first attempt with this theoretically-faster AC2600 successor, which upgrades the internal hardware to 512GB RAM and dual-core 1.7GHz ARM Qualcomm IPQ8065 CPU, and increases the Wi-Fi chops to 1,733Mbps on 5GHz and 800Mbps on 2.4GHz (that's compared to the previous 1,300Mbps and 600Mbps, respectively).

That said, speed and specs aren't really Synology's main selling point – it's the software running under the hood that's the really unique element. The company's SRM (aka 'Synology Router Manager') interface works just like the one on its NAS products – it's accessed through a web browser and gives you a virtual desktop environment, complete with icons to launch apps and access settings menus, which all open in 'windows' that you can drag around and re-arrange within the browser interface. This can make it a bit easier to grasp for complete router newbies, but the real reason you'd choose a Synology router is the ability to download NAS-grade apps to extend functionality.

That includes the likes of Download Station, a sophisticated download program that supports not just HTTP and FTP-based downloading, but BitTorrent and usenet, too; then there's Cloud Station, which lets you host your own cloud-storage server (a-la Dropbox or Google Drive) and remotely sync files to Windows, Mac, Linux, iOS and Android devices; and there's also File Station, a Windows Explorer-style file manager that lets you manipulate the contents of any USB-connected drives from the SRM web interface.

There's a heap of higher-end features, too, like VPN client and server options, a DLNA media server and per-device parental controls with two preset blocklists (either 'malicious' or 'malicious and adult' sites) and the ability to either black- or whitelist additional domains. You can also set a schedule to allow or deny specific devices internet access at certain times of day and there's even Apple Time Machine support for Mac backups.

Synology's main problem is that the selection of apps is fairly limited at present (eight at the time we tested). Despite Synology's NAS boxes having a wide selection of third-party and open-source offerings, there hasn't (so far) been much interest in replicating that for the company's routers... there seemingly hasn't been enough demand to make it worth the devs' time.

Still, the RT2600ac is otherwise a joy to use and, while it doesn't quite make setting up more complex networking/NAS features idiot-proof, it does go some way to making the process more straightforward than on other routers. The Wi-Fi performance was quite adequate in testing, too, with good coverage (thanks in part to the four large detachable antennae) and speeds that largely matched other AC2600 devices we've benchmarked.

You'll pay more for the extra features on offer here, but if you can genuinely use them, the RT2600ac is a top little router.

Dan Gardiner

Verdict

Features ★★★★½
Performance ★★★★
Value ★★★½

A compelling mix of NAS and router, though you do have to pay more for those advanced features.

★★★★☆

M.2 NVME SSD

$189 | WWW.SAMSUNG.COM/AU

Samsung 960 Evo 250GB

Proof that a smaller cache comes at a cost.

Samsung's premium Pro drives are pretty much the go-to SSDs for enthusiasts seeking the best in solid-state storage performance. The latest 960 Pro is a barnstormer of an SSD. But it ain't cheap. In 512GB M.2 configuration – the smallest option – it rocks in at $449. That's where the 960 Evo steps in, again in M.2 format. Like previous Evo models, it gives you much of that Samsung SSD goodness, just in a more affordable package, in theory.

The core specs look promising. You can have it in 250GB format, as tested, which brings the price down dramatically, at well under half the price of the smallest Pro. The Evo also comes with the Polaris controller chip – Samsung's latest – with which comes support for both quad-lane PCI Express 4.0 connectivity and the solid-state-friendly NVMe control protocol.

Where things begin to differ involves the flash memory. Both drives sport Samsung's cutting-edge V-NAND, so-called because of the layers (48 of them) of memory cells, stacked vertically atop one another. The difference with the Evo compared to the Pro is that it gets triple-level cell memory to the Pro's dual-level. The former makes for greater data density and thus lower prices. But it also comes at a cost to both performance and durability.

In terms of the official specs, the peak sequential numbers look solid at first glance. Samsung says it's good for 3.2GB/s reads and 1.5GB/s writes. The latter is a fair distance off the 2.1GB/s of the smallest 960 Pro, for instance, but it's still a big old number.

Look closely at the spec sheet, however, and you'll note that write performance is enabled by the SLC write cache, a block of flash memory running in single-level mode and acting as a write buffer. For this 250GB drive, it measures 13GB. If you exhaust the cache, performance drops off dramatically. Samsung says sustained performance once the cache is filled comes in at just 300MB/s. Yikes.

Drive endurance, meanwhile, tumbles from 400TB for the entry-level 960 Pro to 100TB. Samsung clips the Evo's warranty down to three years from the Pro's five, too. That said, there's less collateral damage to the cost-cutting when it comes to random access performance. The Evo 250GB is good for 330K IOPS reads and 300K writes.

The Evo delivers on its claimed peak performance in a benchmark like ATTO, with 3.2GB/s reads and 1.5GB/s writes. More nuanced metrics that sidestep tricks such as on-the-fly compression, however, show the limitations of the Evo's cost-conscious config. For starters, it only musters around 1.7GB/s reads in CrystalMark's sequential benchmark.

The more revealing measure is the 89 seconds the Evo needs to motor through our 30GB internal file copy test – roughly twice as long as the Pro. On the other hand, the Evo is seriously slick in CrystalMark's 4K random access tests.

How much you're worried by the patchy sequential performance depends on your workloads. The Evo is still fast, but if you routinely shunt large files around, you will inevitably keep bumping into the limitations of that SLC cache. Those caveats aside, this is a nice little M.2 drive from arguably the best in the SSD business.

Jeremy Laird

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

Not as amazingly speedy as its 960 Pro sibling, but given it's quite a bit cheaper that's a fair compromise.

★★★★½

ASUS Z270 SERIES MOTHERBOARDS

OUTSHINE THE COMPETITION

intel CHIPSET Z270 inside

SUPPORTS intel CORE inside

BEST-SELLING

- World's No.1: Most motherboard sales for over 10 consecutive years, with over 500-million sold since 1989.

WORLD'S NO.1 MOTHERBOARD BRAND

EASY TO USE

- Aura Sync: World's 1st synced RGB lighting with intuitive and comprehensive controls to orchestrate Aura Sync-capable hardware.
- 5-Way Optimization: One-click system-wide overclocking and cooling tuning, with uniquely tailored profiles.

ASUS AURA SYNC

STABLE

- 5X Protection III: Multiple hardware safeguards to protect components from damage by power or electrical surges.
- 790+ DDR4 Modules Supported: Industry-leading DDR4 memory compatibility for best flexibility and reassurance. *Precise support varies by model.

5X PROTECTION III

TRUSTED

- Most Awards from last gen: 2X more accolades than all other brands combined, making ASUS the brand you can trust.

2X AWARDS THAN OTHER BRANDS COMBINED

The **BEST** Motherboard – **B**est-selling | **E**asy to use | **S**table | **T**rusted

ASUS Australia & New Zealand www.asus.com.au

apc RECOMMENDS

Z270 MOTHERBOARD

$599 | AU.MSI.COM

MSI Z270 XPower Gaming Titanium

A Z270 return for the silver surfer.

MSI's XPower Gaming Titanium is the new Z270 from the Micro-Star labs, and boy is she pretty. Lacquered in black and silver, this ATX motherboard is striking. Designed for overclockers seeking the maximum level of performance possible, it supports a plethora of overclocking choices, including voltage measure points, an additional section of PCB with onboard buttons to increase and decrease voltage and multiplier, and full support for LN2 and disabling fast boot mode, to whip those high-end frequencies into shape.

Resting snugly in the middle of the bank of PCIe slots is a thin, detailed strip of metallic alloy, adorned with the words 'M.2 Shield'. It addresses one of the biggest issues M.2 PCIe drives face: thermal throttling. Regardless of whether you have a $1,699 2TB Samsung 960 Pro, or a $190 250GB 960 Evo, you're going to encounter thermal throttling issues. Samsung claims that its new 960 Pro drives dissipate just enough heat that they don't begin to throttle until after 333GB of data has been transferred on to or across from the device. That's a hefty figure, but as you reduce price, thermal throttling becomes more of an issue.

This is where MSI comes in. The M.2 shield is comprised of the metal top and an additional thermal pad below the guard. This touches the very top of the memory chips on the M.2 drive, drawing heat up and away from it, and into what effectively becomes a heatsink. This means that more aggressive workloads can be handled for longer, without the drive throttling.

The inclusion of three M.2 ports, RAID-enabled for astronomical sequential reads and writes, is a nice touch. And although we're still not certain whether it's a dud or not, Intel's U.2 connection standard is also supported below the usual plethora of SATA ports.

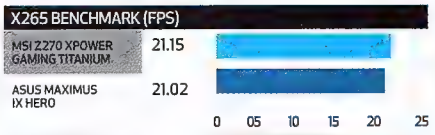
We weren't super impressed with how well the Titanium performed this time around. As we write this, we're still strictly under NDA, with Intel not set to launch its new Kaby Lake desktop experience for at least another two weeks – however, first impressions are hardly overwhelming, especially for an overclocking board. In our tests, we achieved lower overclocks, with higher voltages, across our testing range. The XPower needed 1.3V on the Vcore to achieve 5GHz on our current Core i7-7700K, versus the ASUS Maximus IX Hero's 1.27V. It achieved a maximum stable overclock of 5.0GHz, versus the ASUS's 5.1GHz. And the lowest voltage we managed to keep the core running stable with at stock was a dismal 1.09V, versus the Hero's 1.07V.

Now, you could say we're splitting hairs here, but the Hero is designed to be a mainstream board, while the XPower is aimed at the upper echelons of world record breakers. We may see some improvement in the future, thanks to BIOS updates and software reworkings but, for the time being at least, the XPower doesn't quite hit the mark.

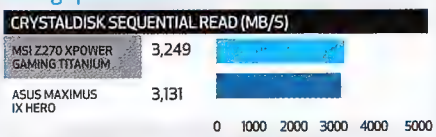
■ Zak Storey

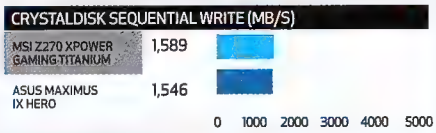
LABS BENCHMARK RESULTS

General performance

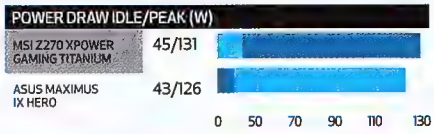


Storage performance

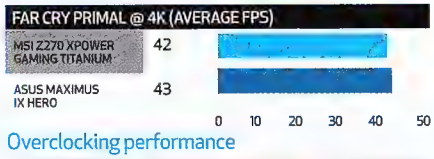




Power performance



Gaming performance



Overclocking performance

Verdict

Features	★★★★½
Performance	★★★★☆
Value	★★★☆☆

A very good board with a compelling mix of features and performance, but somewhat hard to justify at this price.

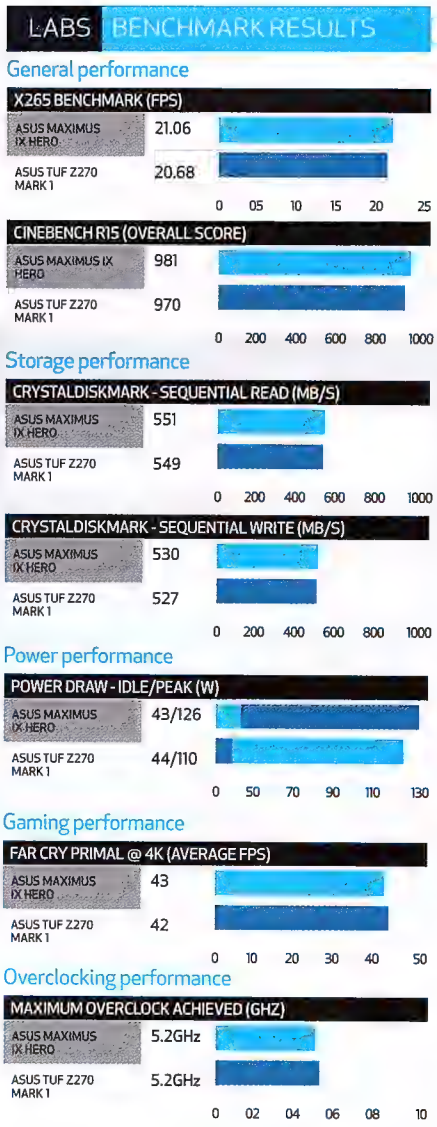
★★★★☆

MOTHERBOARD

$439 | WWW.ASUS.COM/AU

ASUS Maximus IX Hero

Small changes, big difference.


LABS BENCHMARK RESULTS
General performance
X265 BENCHMARK (FPS)
ASUS MAXIMUS IX HERO 21.06
ASUS TUF Z270 MARK 1 20.68
0 05 10 15 20 25
CINEBENCH R15 (OVERALL SCORE)
ASUS MAXIMUS IX HERO 981
ASUS TUF Z270 MARK 1 970
0 200 400 600 800 1000
Storage performance
CRYSTALDISKMARK - SEQUENTIAL READ (MB/S)
ASUS MAXIMUS IX HERO 551
ASUS TUF Z270 MARK 1 549
0 200 400 600 800 1000
CRYSTALDISKMARK - SEQUENTIAL WRITE (MB/S)
ASUS MAXIMUS IX HERO 530
ASUS TUF Z270 MARK 1 527
0 200 400 600 800 1000
Power performance
POWER DRAW - IDLE/PEAK (W)
ASUS MAXIMUS IX HERO 43/126
ASUS TUF Z270 MARK 1 44/110
0 50 70 90 110 130
Gaming performance
FAR CRY PRIMAL @ 4K (AVERAGE FPS)
ASUS MAXIMUS IX HERO 43
ASUS TUF Z270 MARK 1 42
0 10 20 30 40 50
Overclocking performance
MAXIMUM OVERCLOCK ACHIEVED (GHZ)
ASUS MAXIMUS IX HERO 5.2GHz
ASUS TUF Z270 MARK 1 5.2GHz
0 02 04 06 08 10

Kaby Lake has launched, and we're on our way to being buried by the latest and greatest from the big three motherboard manufacturers. These boards have been in development for some time, and with the first murmurs heard back at CES 2016, it's easy to understand why manufacturers are so eager to get their foot in the door, and your money in their pockets.

Here we have the mainstay of ASUS's motherboard arsenal and a follow-up to one of its best-selling mobos of all time. The Maximus IX Hero is a beauty. ASUS has done away with the black and red of its 8th-generation RoG predecessor, opting for a dark black and metallic aesthetic instead. The reason is that, if you have a red motherboard, it's not going to work well with any colour other than red, white or black. This new aesthetic, combined with the lighting on both the chipset and the rear I/O plate, ensures that you can colour-coordinate your system without worry.

ASUS has included an additional M.2 port below the processor, two more fan headers along the side closest to the 24-pin power, a direct USB 3.1 port on board, and it's relegated the USB 3.0 front I/O connector to the bottom of the board, as opposed to its usual position cosying up to the 24-pin. On top of that, ASUS has stripped the Maximus IX Hero of SATA Express ports entirely, and as a result, it's also lost two of the SATA 3 ports. Considering the damp squib that SATA Express became, we're not sad to see it go.

An interesting change we didn't expect is the lack of U.2 port, especially as ASUS reintroduced the Hero Alpha featuring the U.2 port as standard. Diving into the box, there isn't even an M.2-to-U.2 adapter. This suggests that ASUS isn't putting as much faith in U.2 as it is M.2, which makes sense, especially when you consider just how tightly locked Intel has the U.2 connection standard. And with the likes of Samsung producing some fantastic M.2 drives, with higher capacities and better performance than many of Intel's best U.2 SSDs, we're not particularly surprised.

BIOS-wise, the Hero IX is the same familiar affair we're used to. Overclocking features remain resolutely identical to Z170, with trademark tools such as ASUS Enhanced Ratios and the ability to adjust the VRM efficiency still remaining inside AI Tweak.

The board's overclocking performance is strong, as well, with our chip achieving an impressive 5GHz, with a meager 1.25V on the VCore. VDroop is less than 0.01V, and overall performance is very similar to our other ASUS board.

All in all, this update to the Hero board changes a good deal of aesthetic properties, while removing a lot of the wasted space allocated to older connection standards that just weren't cutting it anymore. We do wish ASUS had included one additional USB 3.0 internal header, but otherwise, there's very little for us to complain about. If you're thinking of upgrading from Ivy Bridge or Haswell, the Maximus IX Hero, in combination with a Core i5-7600K or above, is a fantastic solution.

Zak Storey

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½

It'll be overkill for many, but the Hero once again offers a great package for more-demanding users.

★★★★½

$319 | WWW.SEAGATE.COM/AU

Seagate Backup Plus Portable 5TB

It's true — size really does matter.

Seagate's latest Backup Plus external hard drive is newsworthy for one thing: its absurdly large 5TB storage capacity. Sure, 5TB is a few thousand gigs shy of the company's groundbreaking 8TB USB Type-C powered Innov8 external hard drive, but the Backup Plus is smaller and lighter than the latter, but still functionally similar and, moreover, far more affordable.

Capped in a black, silver, red or blue metal façade, this compact drive fits neatly into its slightly frumpy plastic casing. The square shape might be a little boring, but pragmatically speaking, this is an exceptionally high-capacity drive that's only a little over twice as thick as its thinnest (and more space-restricted) siblings. In other words, it's still exceptionally portable.

While there's only a slower 5,400rpm internal drive under the hood, the high data density means this 5TB unit was able to achieve a 10% speed boost over comparable drives we've tested in the past. The device's sequential read and write speeds were a high 143MB/s and 134MB/s, respectively, using CrystalDiskMark 3.0.4 — although the scores did fall back to more normal levels for working with smaller 512KB files, with read and write speeds of 44MB/s and 70MB/s.

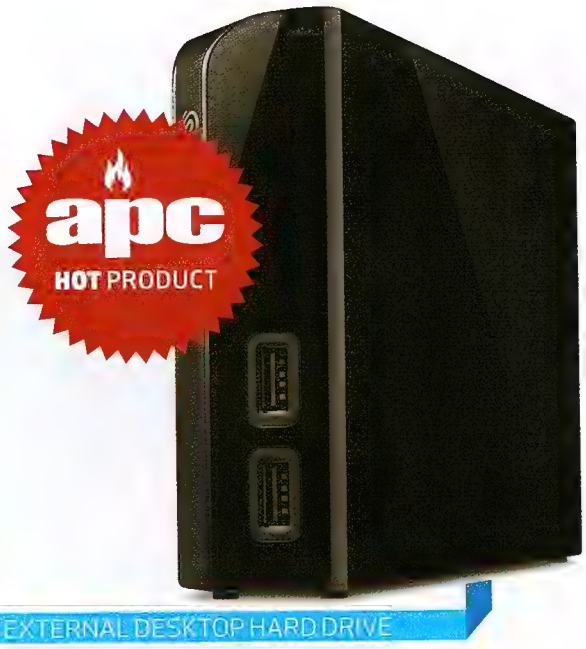
The USB 3.0 Type-A to micro-B cable gives the drive ample power when it needs it, and remains compatible with older USB 2.0 computers. That $319 price might seem a little high for a portable drive, but the Backup Plus actually provides an unparalleled cost-to-capacity ratio of 6.4 cents per GB. And with 200GB of OneDrive storage and Seagate's suite of backup software to boot, it's genuinely hard to fault the 5TB Backup Plus Portable in any real way.

Joel Burgess

Verdict

This fast and compact portable drive is great value considering its generous storage capacity.

★★★★★



$419 | WWW.SEAGATE.COM/AU

Seagate Backup Plus Hub 8TB

Hubba Hub-ba!

Desktop external storage hasn't seen the same dramatic capacity increases as portable drives in past years, and though 8,000GB of disk space is in no way an insignificant amount, it's not quite revolutionary for an external desktop-bound drive. That said, when you consider what consumers are looking for in a new hard drive, 'exciting' probably isn't a factor that we'd expect to be high on anyone's shortlist. Value, speed, size and features, on the other hand, probably will be and the 8TB Backup Plus Hub pleasingly manages to excel in all four of those categories.

On the beveled front edge of this desktop drive's plastic case are a pair of USB 3.0 ports that double as conveniently located places you can charge a phone or tablet or, alternately, plug in portable USB drives to backup to the Hub's own internal storage. Obviously, this is where the unit gets the 'Hub' element of it's name from and it's a neat addition that you'll generally only come across in higher-end NAS boxes... despite every desktop drive theoretically having the higher capacity, power and onboard USB hardware to do so.

There's naturally a bit of a speed boost associated with bigger 'desktop' external drives (at least compared to their portable cousins) and the Backup Plus Hub's sequential read and write speeds of 198MB/s and 188MB/s, respectively, are testament to that. When you consider that most portable drives hit between 110MB/s and 125MB/s, that's a considerable jump, meaning doing system backups will be quicker, as will editing big media files stored directly on the drive.

At $419, this 8TB drive also works out to be exceptionally good value at 5.2 cents per gigabyte and with the additional hub perks, this is one highly desirable digital storehouse.

Joel Burgess

Verdict

A fast and affordable proposition for those requiring a generous storage upgrade.

★★★★★

$200 | WWW.BITFENIX.COM

BitFenix Pandora ATX

High-quality PC case craftsmanship.

BitFenix has continued to turn away from the traditional 'rectangular box' PC case in search of more outrageous designs, and the Pandora ATX hits the mark.

The showpiece is the LED logo at the front of the case. Connecting to the mobo via a single internal USB header, you can change and adjust the logo that's shown on the 2.8-inch colour display through software. This option isn't available on the more budget-friendly Core variant, though.

The internals look good, too. There are mounting trays for two 2.5-inch SSDs to be displayed through the window, a 3.5-inch mount just above the PSU cover, and a rubberised pump mount, too, along with the usual plethora of rubber grommets. Looking behind the motherboard tray, you'll find two additional 2.5-inch mounts and a second 3.5-incher, as well.

There's a recessed radiator port, supporting up to a 360mm radiator in the roof, followed by additional support in the front for one more 360mm. You can hide both of them if you desire. The Pandora also comes with an integrated reservoir mounting system in its roof. There's still ample room for traditional tower coolers and AIO solutions, too.

However, it isn't without its caveats. The steel side panels feel flimsy and the rest of the case is made from a type of ABS plastic that feels a little brittle. On top of that, the pop hinges don't provide much of a handhold.

But the dust filters located under the PSU, on the roof and in the front panel are intuitive, and help to keep it clean, and for the price, it's hard to beat.

Zak Storey

Verdict

An unconventional case that still hits the mark thanks to smart design.

★★★★☆

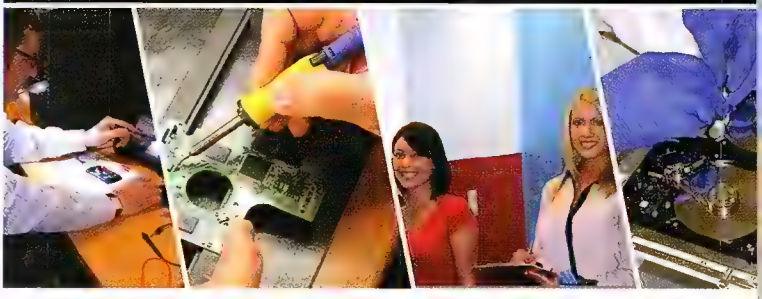
PAYAM Data Recovery

AUSTRALIA'S #1 DATA RECOVERY COMPANY

OFFICIAL WESTERN DIGITAL DATA RECOVERY PARTNER IN AUSTRALIA AND NEW ZEALAND

THE ONLY AUTHORISED SEAGATE DATA RECOVERY SERVICE PROVIDER IN AUSTRALIA AND NEW ZEALAND

EXPERT DATA RECOVERY FROM Damaged Hard Disk Drives, SSD, RAID, NAS, Mobile Phones, USB Flash Drives and Memory Cards.



Are you an IT Professional?
Join our Free Partnership Program today.
www.payam.com.au

See our CLASS-100 CLEAN ROOM at www.payam.com.au

Data Recovery Labs in Sydney, Melbourne, Brisbane, Perth, Adelaide and Auckland (New Zealand)

1300 328 273 help@payam.com.au

www.payam.com.au

$130 | WWW.ROCCAT.ORG/EN-AU

Roccat Cross

Design and function versatility make this a winner.

The Cross's relatively unassuming all-black design doesn't take the 'mean' approach that many other gaming headsets adopt (we're looking at you, Logitech), meaning it's visually versatile.

These cans are super lightweight, at just 185g, and the earcups are ergonomically shaped internally so as to fit around the ears. The extendable headband is a little stiff but also strong, and the cups offer a fairly generous amount of rotation. The underside of the headband and cups are made with memory foam covered with leatherette – this coupled with their low weight adds up to a pleasant wearing experience for up to a whole day, and you're likely to forget you're wearing them.

The Cross features large "studio grade" 50mm neodymium-magnet drivers, which end up making these sound a tad bass heavy, but the mids and highs are still crisp, meaning they work really well for gaming. Plus, this set has some serious punch when listening to certain genres of music, such as industrial – quite unexpected from a unit this compact.

The main drawcard is its versatility in function. The Cross does away with the need for multiple pairs of headphones, as it comes with both a boom-arm mic for gaming and office use (on a 2.35m-long, four-pole dual-jack 3.5mm cable) and a petit inline mic for mobile use (on a shorter 1.2m-long 3.5mm cable). We do wish the inline mic had squeezed in some media controls, though. The two mics are simple to switch out via a port in the left ear cup – but there's sadly no quick mic mute control, like seen on the Kraken (see left). The left ear cup does include a handy volume control that's smooth but also stiff enough to avoid being moved accidentally. The mobile mic was adequate, but the boom mic adds noise-cancelling – a benefit for work and play.

If you don't mind its few tiny flaws, this is a unit that you'll definitely be happy to show off... both *in* and *out* of the house. ■ Carmel Sealey

Verdict

Not quite the one set to rule them all, but lightweight and versatile nature make a great buy.

★★★★½

$169 | WWW.RAZERZONE.COM

Razer Kraken 7.1 v2

A different kind of monster.

The ear cups on this headset are on the large side, with the 50mm audio drivers but you can bet this is what helps them sound so great – and those drivers can be custom-tuned through Razer's Synapse software (though we were happy with the default settings).

The Krakens boast 7.1 virtual surround sound. While not as good as being surrounded by speakers, the headphones do a convincing job in-game, as well as just listening to music. In testing, we mostly played *Dishonored 2* with them on and both the subtle sounds of distant bloodflies and lapping water, and the sharper screeches and clanking of the overhead trains were perfectly heard from all directions. The sound in general is quite well balanced and sharp, too.

The aluminium frame is sturdy and holds the cups very securely in place, with no movement of rotation. The cushioning across the band initially seemed a little thin, but ended up being comfortable, as did the cups, which are padded with memory foam. Despite being circular in shape, the cups are big enough that they should adequately fit over most people's ears and lend themselves to extended periods of use.

The Kraken sports a pliable mic that retracts back into the left cup – a nice touch – and the noise-cancelling feature can be activated using Synapse. The tip of the mic doubles as a squeezable mute button, too, which makes it easy to find by touch alone.

The braided cord is a generous 2m long, and then there's the Chroma LED lighting, offering 16.8 million colour options. The logo on each cup can be programmed with three different lighting patterns including a static colour, breathing and the spectrum effect, which we preferred.

Something we'd like to have seen, though, is media controls, but that's hardly a deal-breaker.

For a gaming headset, these upgraded Krakens sound and feel great, and have become this reviewer's current go-to set.

■ Carmel Sealey

Verdict

Compatible with PS4, Windows PCs and Macs (though not Xbox), the Krakens are comfy and reliable.

★★★★½

apc RECOMMENDS

GAMING HEADSET

$469 | WWW.ASTROGAMING.COM

Astro Gaming A50 Wireless + Base Station

Astro ups its game with this fantastically mature and powerful headset.

If you're after a top-of-the-range wireless gaming headset, pick up this gadget – you will not be disappointed. You get Dolby Headphone 7.1 surround sound with built-in MixAmp tech, a 5GHz low-latency wireless connection over 9m, 15 hours of battery life on a single charge, a pro-grade microphone with flip-up mute and a headset with three distinct EQ profiles that can be added to or tweaked with Astro's bundled software.

In other words, you get a lot of bells and whistles. The A50s come in a black-and-blue colour scheme for PS4 compatibility or grey and green for Xbox One compatibility (both sets also work with PC and Mac). In the box, you get digital audio and USB-to-micro-USB cables, which are required to transfer audio data and power from your console or computer to the Base Station, which is a cool, black slab indented at the top with a recess for depositing the 'phones in when they're not in use.

Within this recess lies a brace of small-scale power prongs which, when the headphones are slotted in, make contact with small receptive power plates on the bottom of one of the headset's ear cups, thereby charging them for wireless operation.

Sticking with the Base Station, on its front lies a number of indicator lights, highlighting things such as power and charge level, while at its rear lies in and out digital optical ports, a micro-USB port and an AUX out. As such, not only can you connect the Station to your console or computer, but you can also bring in sources from elsewhere.

The headset is an over-ear design of industrial, futurist beauty. Chrome, perforated, hollow tubes extend from the chunky, rubberised-finish earcups up to a robust, cushioned headrest.

On the earcups lie buttons, switches and dials, which handle things like power, profiles and volume, as well as the headset's raise-to-mute microphone, which is positioned on the left cup.

Audio quality is, as you would expect from a gaming headset, inclined slightly toward the low-end, with distortion-free bass, while the immersive surround sound is absolutely superb. The volume range is also excellent.

Connectivity range, providing you don't put thick stone walls between you and the Base Station, is also pleasingly large.

Battery life, too, despite us not sitting there with a stopwatch, also seems on the money at around the 15-hour mark. Charge the A50s to full power and you can forget about having to charge them for quite a while, which in our case sometimes stretched out to over a week.

Overall, we had a great experience with the Astro A50 Wireless. Everything about this gaming audio system just screams premium – except the fabric ear-cushions and headband cushion (which can be upgraded to synthetic leather). These factors and the price stop it from landing a perfect-5 score, but we have no problem recommending them if you're on the market for a premium gaming headset. ■

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★

They're costly, but offer superb performance, first-rate battery life and a classy style. Worth considering.

★★★★☆

GAMING HEADSET

$170 | WWW.STEELSERIES.COM

SteelSeries Arctis 3

Cool, but by no means calm, audio.

While the Arctis 3 lacks the USB connectivity and RGB lighting of the Arctis 5 and the wireless convenience of the Arctis 7, it's still toting the lion's share of SteelSeries' genius.

So, let's start with that funky ski-goggle headband. It makes the Arctis 3 very adjustable and, once you've set it up, monumentally comfortable. It does take a little getting used to, since it seems to exert more direct pressure across your dome than a traditional padded band would, though.

The modular cabling is long and stylishly grey. It gives you the option of switching between a four-pole and a pair of three-pole jacks in a tidy way. It is also a colossal pain in the rear. Several times during our test, we had the worry of audio dropping out, where the cable had worked its way loose because we'd moved our head slightly.

The slide-out bendy mic is super neat, and among the best we've tested in this price range. It's clear, sensitive and stands up very well to being boosted by software. However, it doesn't seem to want to stay exactly where you've put it, and it's an absolute magnet for breathing noises. What's more, the mic mute function is reached through a tiny, lightly recessed button on the right ear cup; finding it while wearing the headset is hard.

Despite a couple of questionable design choices, the Arctis 3 is a well-constructed, sexy-looking set of closed-back cans, with 90-degree earpiece rotation and pillow-soft velour pads. It's light, and we found it a lot less tight on the head than many other headsets.

But the audio quality is fantastic. There's a brilliant, well-balanced sound stage, one that doesn't fight you with overwhelming bass, or pierce your ears with spiky treble. The middle doesn't get lost, and the details remain pin-sharp. And while the 7.1 surround didn't blow us away like we thought it might, this is a definite contender in the audio stakes – niggles and all.

Alex Cox

Verdict

Fantastic audio quality and soundstage combine with a comfortable fit. A great little set.

★★★★☆

GAMING MOUSE

$199 | WWW.MIONIX.NET

Mionix Naos QG

Watch how you play, as you play.

The Naos QG is the first mouse we've seen since the introduction of the laser sensor to truly rethink what you can do with the wily peripheral. Consider being able to track your heart rate while you're using your PC, linking and synching programs with it. Whether that's for health reasons or purely for entertainment, it's an interesting concept.

Link a game to a heart rate sensor and you could have it react according to how you're behaving. The Naos QG comes with an IR-based heart rate sensor to the left-hand side of your right palm and the GSR to your right. With an Overwolf overlay on screen, you can see your heartbeat displayed. In game, it's a little unnerving to see how your body reacts. As your hairs stand on end in terrifying scenes, the mouse detects the changes, and vast spikes running along the outside edge of the overlay make it painfully apparent that you're ruffled. That brings us to who this was initially designed for – streamers and content creators. It adds another layer for the audience to view your reaction.

That aside, this is still an ergonomically well-crafted tool. For right-handers only, the Naos supports your ring finger and pinky, nestling you into place naturally. It's big, but still feels quick and agile. The RGB lighting is there, along with polling rate adjustments, DPI and lift-off sensitivity. It boasts a soft-touch rubberised grey finish, making it resistant to grease and sweat.

The software is still in its infancy, however, and the heart rate sensor is jittery. Sometimes, you go from 70bpm to 150bpm, with little to no explanation. No doubt it'll be something that's ironed out in firmware and software updates, but it is still a concern.

But this is a good mouse. It's currently targeted at a very niche audience, but as it is somewhat of an open standard, with a set of open APIs, it may very well be something that we see a lot more of going forward.

Zak Storey

Verdict

It's a nice product, to be sure, but the heart-rate feature is neat and it's comfy and quick in use.

★★★★☆

AORUS

YOUR GAME. YOUR WAY.

ASCEND TO GREATNESS

AORUS GAMING MOTHERBOARDS

GIGABYTE™

www.gigabyte.com.au

software

» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

HandBrake

An extremely powerful video and audio converter that's also totally free.

FREE | HANDBRAKE.FR

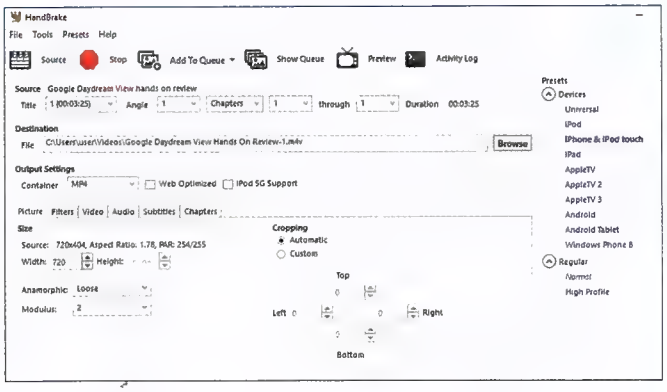
HandBrake is a free video converter that's fairly well known to Mac users, but less famous in the world of Windows. It is worth noting that this is still something of an experimental program and it hasn't even reached version 1.0 in its Windows incarnation, but that doesn't mean it should be overlooked.

Available for Mac, Windows and Linux, Handbrake is a great choice for anyone who works on multiple platforms, but is also great for anyone who is dedicated to Windows.

The app certainly is: it's a fantastic tool for ripping DVDs (or other kinds of video disc) or converting audio or video files from one format to another — although we should mention that HandBrake is not compatible with copyright-protected DVDs. However, the open-source software comes into its own when converting home-made Blu-rays and DVDs, or videos downloaded from the internet to a format compatible with your smartphone or tablet.

Not only does Handbrake provide extensive options for pixel perfectionists, but it comes with a really useful stack of presets that provide one-click access to common formats. If you've ever wrestled with trying to convert video for an iPhone, PSP or other device, you'll be clicking the download button already.

It's not just about devices, though. It can transcode between H.264, H.265, MPEG-2, MPEG-4, VP8 and Theora, and its audio powers include AAC, CoreAudio AAC/HE-AAC, MP3, FLAC, AC3 and Vorbis. That means it's a great tool for converting any kind of video media into whatever format you need.



There are a lot of features that allow for fine-grained control of video conversion, too — including very precise cropping, advanced filtering, frame rate adjustment — but there are also presets for those who just want quick and simple results.

Finally, Handbrake has made its way to Windows. It may take a little while to get used to — as it's a full-featured app — but the output is worth the effort.

Mark Wilson & Gary Marshall

Eraser

Remove every trace of unwanted data from your PC.

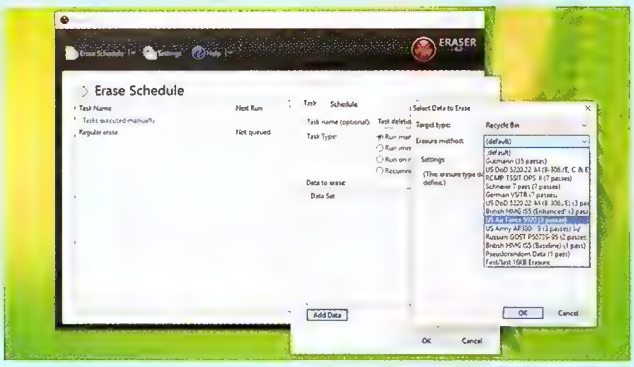
FREE | ERASER.HEIDI.IE

When you delete files from your PC, they aren't immediately erased — Windows only removes references, and marks it as available to be overwritten. Until that happens, the data can be restored quite easily using specialist recovery software.

To completely remove sensitive information, you need to either physically destroy the hard drive (a drill, hammer or the fiery magma of Mordor will usually do the trick) or take advantage of a program like Eraser, which permanently purges data by overwriting it multiple times using random data patterns.

This means that Eraser can delete cached usernames and passwords, purge personal details that need to be erased and wipe all data from a hard drive if you're planning to sell it.

Unlike some other programs of its type, Eraser not only lets you purge certain files or directories, it also lets you set up



tasks for erasing content that you want to clear out regularly. Morevoer, if you've already deleted files without a secure removal tool and think there might be traces left behind, you can even use Eraser to securely wipe and rewrite all 'unused' space, just to be sure. **Cat Ellis**

Camtasia 3

Record, edit and share the contents of your screen.

$259.70 | TECHSMITH.COM

Camtasia enables you to record, edit and share your Mac's display as a movie. It's a popular tool with educators in particular, because they can show their audience how to fix a picture in Lightroom, for example.

Version 3 has a more polished look, though because the key panels are in the same relative positions to version 2, there's no need to re-learn the app if you're an old hand.

But while the basic cake may not look too different, there's a lot more icing to work with here. The new Behaviors panel lets you drag and drop eye-catching animation presets onto assets such as text. The welcome Split button enables you to cut a timeline's clip in two without having to right-click on the playhead. And all music tracks included with Camtasia are royalty free, and fine to use on YouTube and Vimeo, which is super handy.

You can also now make your video productions more interactive by incorporating multiple-choice quizzes and even personalise your captured movies by adding the feed from your FaceTime camera as you record.

With Camtasia 3, a Mac user can now deliver the project to a non-Mac Camtasia user, who can then fine-tune it. This cross-platform compatibility will be welcomed by many professional Camtasia users.

The only significant issue we have with Camtasia 3 is the eye-watering price tag. That said, there is a free 30-day trial available, so you can try it out and establish whether the software is really worth the money you'll have to dish out to fulfil your particular needs.

At the end of the day, though, this is a slick post-production application with the tools to make eye-catching videos, but with an equally eye-catching price that may turn potential users away.

George Cairns

iStat for Mac

Keep an eye on your Macs.

$14.99 | BJANGO.COM

You might be familiar with the iStat Menus utility in the menu bar, providing readouts about Mac activity. iStat for Mac is in similar territory, but for remote-monitoring. Install the server app on the target machine, then add server details (name, address, port). If you're on the same network as the target, iStat will likely pick up the machine automatically. Such user-friendliness is welcome — just as well, given that 'iStat Help' throws you at a support page stating: Help is on the way.

Fortunately, the app is elsewhere more impressive. The main view displays graphs detailing CPU and network usages, and readouts for disk usage and activity, sensors, memory, load and uptime. You can delve into more detail by clicking the relevant pane.

For stats and admin geeks, this app will be heaven: extensive histories (up to 12 months); network tools (including ping and traceroute); iCloud sync to a similarly impressive iOS app. **Craig Grannell**

WALTR 2

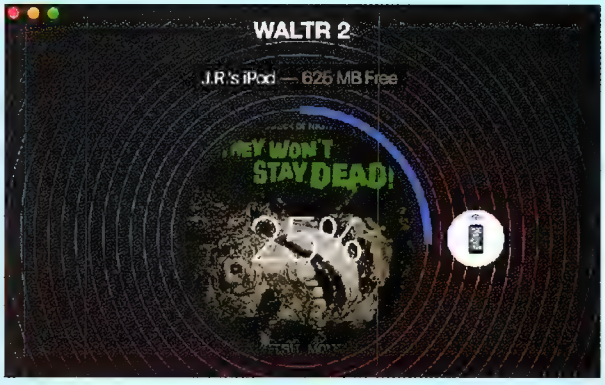
Drag-and-drop media files.

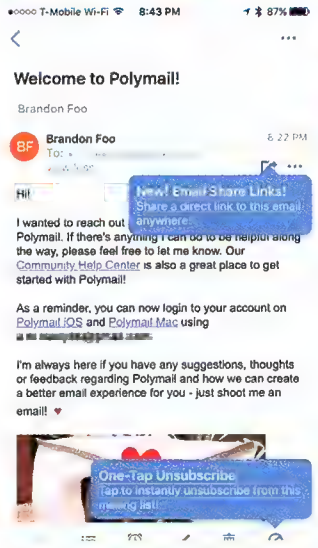
FROM US$39.95 | SOFTORINO.COM

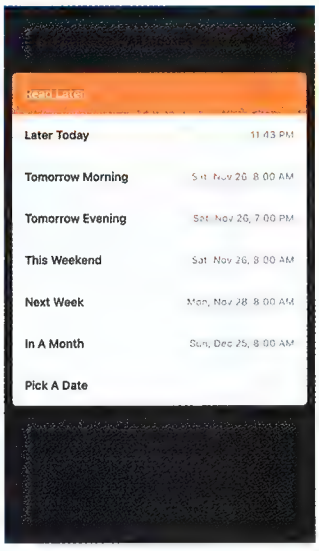
WALTR is a simple utility for converting and transferring videos, music, and ringtones to iPod or iOS devices without iTunes. WALTR 2 is better in every way, from the ability to perform wireless transfers at nearly wired connection speeds (up to 5MB/s) to automatic content recognition for adding artwork and metadata to movies, TV shows or music, together with iBooks support for EPUB or PDF files.

WALTR 2 is the first and only utility that allows ringtones longer than 30 seconds — rename an M4A file with the M4R extension, drag-and-drop to a connected device and the entire song works as a ringtone. You can even mix-and-match file types — WALTR 2 will determine what goes where and perform any necessary conversions. Softorino recommends closing iTunes while using WALTR 2, although the two coexisted fine for us.

It's the best $55 you'll ever spend, and hands-down the slickest way to send media from Mac to iOS. **JR Bookwalter**




Welcome to Polymail!
Brandon Foo
Hi!
I wanted to reach out
Polymail. If there's anything I can do to be helpful along
the way, please feel free to let me know. Our
Community Help Center is also a great place to get
started with Polymail!
As a reminder, you can now login to your account on
Polymail iOS and Polymail Mac using
I'm always here if you have any suggestions, thoughts
or feedback regarding Polymail and how we can create
a better email experience for you - just shoot me an
email!
One-Tap Unsubscribe



Polymail

Tackle multiple email accounts on iOS.

FREE | POLYMAIL.IO

We're willing to bet quite a few of our readers have multiple email addresses. Juggling them can get a little bit tricky, especially if you're doing it on your phone. Polymail is an app that aims to help take the frustration out of using multiple emails and comes packed with additional goodies.

Polymail can be used across platforms – on iPhone and Mac – and keeps synchronised with a single Polymail login. You can use the app with all sorts of email accounts, including Gmail, Outlook, Yahoo Mail, iCloud and any email provider that uses IMAP, so it should work well with any email your internet service provider has given you, as well as most email accounts that are provided by offices and schools.

There's a lot of useful features to be used in Polymail. There are email templates that allow you to respond to common questions you get, the ability to undo messages you send if you make a mistake, and delayed message sending so you can make sure your emails are read at the correct time. You'll be able to see when people read emails you've sent them, as well as when they download any attachments – perfect for when you've got time-sensitive material to distribute. You can even create detailed contact profiles with built-in social links and a record of your interaction history.

Our favourite thing about Polymail is the minimal, yet attractive interface. It doesn't feel cluttered in the slightest, and is easy to navigate from the moment you open it. It feels quite a bit like the built-in iOS email app, but with a fresh coat of paint and some additional features you won't find with within the stock Apple app. We think that Polymail is truly one of the more approachable third-party email apps we've come across. We cannot recommend it enough and think that most people will enjoy it once they start using it.

While it's meant for people who use more than one email and those who are business minded, we could see anyone benefiting from making the switch.

Amber Neely

Opener

A smart app extension that fills a void.

$2.99 | OPENER.LINK

It's an app world now, we all just live in it. That is, except when links you tap on your iPhone or iPad open in Safari instead of the app you intended. We still don't have a way to set default apps in iOS 10. Thankfully, now there's Opener.

Put simply, it opens links in the apps of your choice — think of it like using the right-click 'Open With' menu in macOS. Instead of opening YouTube links in Google's app or Safari, Opener can send them to ProTube, a third-party app we prefer. Instead of opening Twitter links in Twitter's official (and rather poor) app, you could open them in Tweetbot or Twitterrific.

We've used Opener almost daily since we found it and we think it fills a functional vacuum quite well. There has never been a way to control default apps in iOS, but Opener is a low-friction way to gain some of that flexibility, and at a fairly reasonable price, too.

One small complaint is the way browsers are handled. If you want to use a browser besides Safari, you only get to pick a single option. We'd rather see all available browsers listed and have the ability to change our choice on-the-fly.

That said, we definitely recommend Opener, and while we wish iOS would make some of these tasks easier by default, we totally get Apple's desire to keep things simple for most users. Thankfully, iOS has the foundational support to allow apps like Opener to exist, and we're glad it does.

So all in all, it's a strong app extension for everyone who needs a little more flexibility from iOS.

David Chartier

Workfrom

Find places to work.

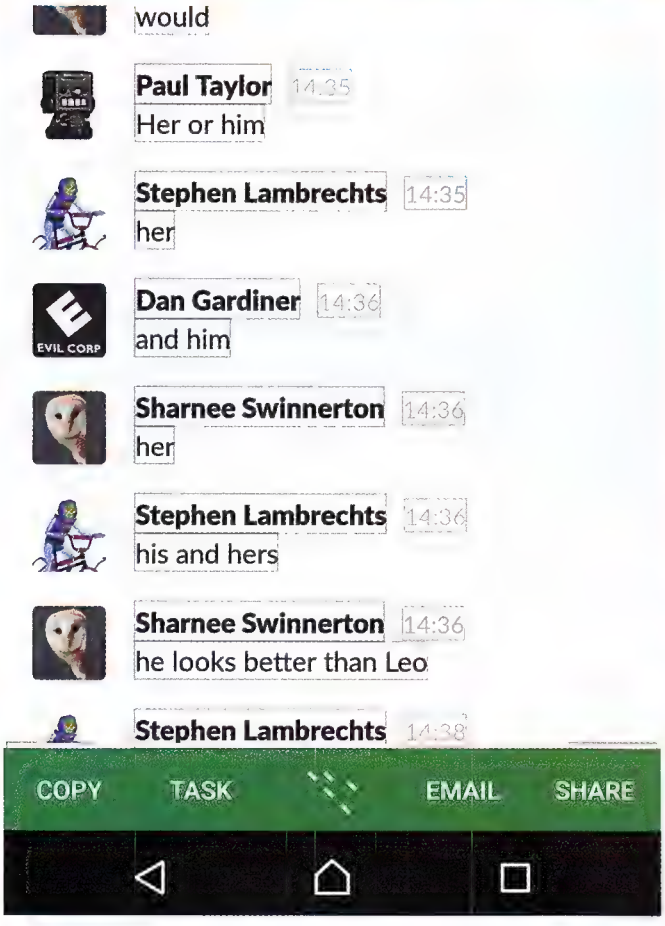
FREE | WWW.WORKFROM.CO

Workfrom aims to apply the community-driven, crowd-sourced approach (which seems to be doing quite well for itself at the moment) to helping people find work-friendly locations, whether it be cafes, bars, restaurants or parks.

Every bit of work-related info you could think of needing has been incorporated in this app — each location features info on Wi-Fi, powerpoints, background noise, capacity, food and even Wi-Fi speeds and passwords. You can search for places nearby or with specific locations in mind, the results showing up either in list or map format, and while the service is quite young, we found there were already plenty of locations in Sydney and Melbourne, with the promise of more if the service takes off.

You can optionally sign up in order to start scouting locations and contributing to the community, as well as accessing some further features, or you can simply mooch off the info that others have gathered. If you're a business that offers the kind of space that Workfrom is looking for, you can also register yourself and get some sweet, sweet promotion while doing so.

Harry Domanski



Clip Layer

Getting textual.

FREE | TINYURL.COM/APC438-CLIP

Text that can't be highlighted and copied is worse than 3% battery when you're waiting for an Uber. Sure, you can take a screenshot, but then the text itself becomes an image — static, undynamic.

Clip Layer works over the top of all apps, boasting that it can select text no matter what app you're using. Handy, say, if you're reading a book through Google Books and want to copy a passage for reference later on, or quickly copy bank account details. Try that in vanilla Android, by pressing and holding on the screen, and you'll be utterly luckless.

It's not perfect, as the text elements in some apps don't match up with the outline Clip Layer draws around them, so while you're stabbing on the words, it's actually copying something entirely different. We also found it worked inconsistently with the mobile browser version of Facebook. And the launcher for the app dominates the long press of your home button, so say goodbye to Google Launcher.

Despite a few limitations and glitches, Clip Layer does prove useful. **Paul Taylor**

Trusted Contacts

Push to stalk.

FREE | TINYURL.COM/APC438-CONTACTS

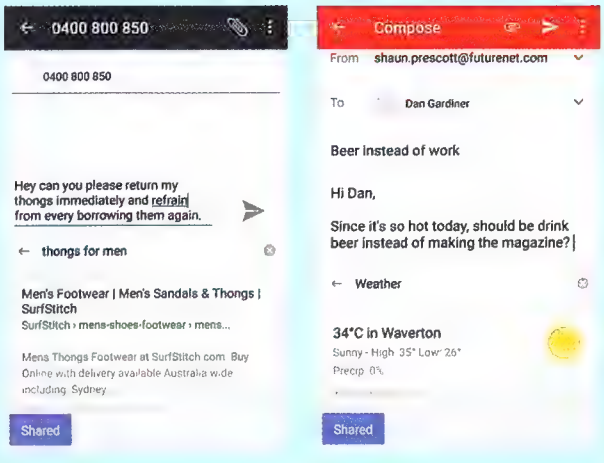
This app allows you to select a group of friends or family who are able to, at any time, request information about your location via your phone's inbuilt GPS. That sounds pretty suss, but the app is geared towards personal safety. If someone on the list asks for your whereabouts, you'll have five minutes to decline the request, after which, it'll automatically start providing the information — for a period of up to 24 hours, unless you cancel it beforehand. This is likely to be an especially attractive app for parents of teenagers, and an especially terrifying app for teenagers of parents. Still, there are numerous real-world situations where an app like this could come in handy, especially for people unexpectedly required to walk home alone at night, or worse still, getting lost in Canberra. **Shaun Prescott**

Gboard by Google

A more flexible and full-featured way of typing.

FREE | TINYURL.COM/APC438-GBOARD

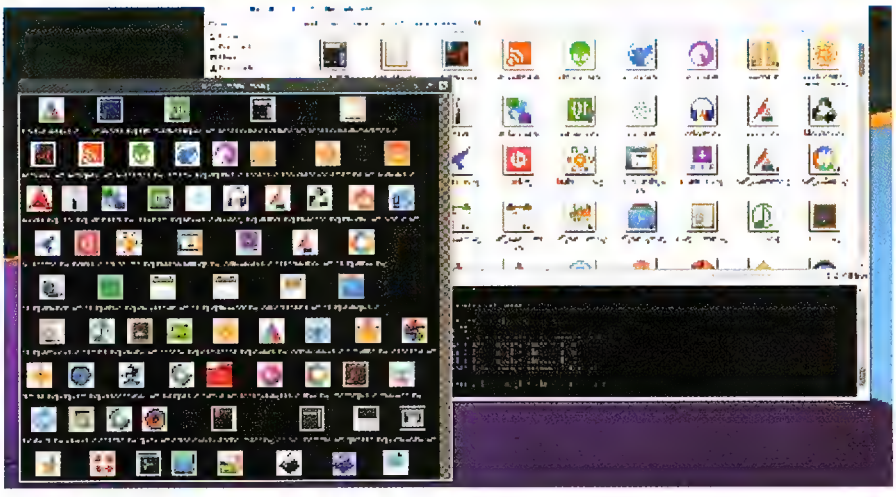
In 2017, it's of high importance that everything do as many things as possible. So if you have an onscreen keyboard, it's not good enough to simply type with it: you should be able to search the entire web with it. You should be able to check and send the weather with it. You should be able to, of course, send GIFs with it. And that's what Google's Gboard update basically does: now when you're sending a text message or writing an email or doing anything involving your onscreen keyboard, you'll see a G logo which allows you to embed certain links and information with no fuss. Say, you want to suggest to your friend that he buy a pair of thongs, it's simple enough to search "thongs" within the keyboard panel and provide the relevant link, without needing to open Chrome separately and then cut / paste the link. It's usually intimidating when companies integrate complex functionality into otherwise very simple services, but this update is easy to use, useful and not at all intrusive when you're not using it. **Shaun Prescott**


0400 800 850
0400 800 850
Hey can you please return my thongs immediately and refrain from every borrowing them again.
thongs for men
Men's Footwear | Men's Sandals & Thongs | SurfStitch
SurfStitch › mens-shoes-footwear › mens...
Mens Thongs Footwear at SurfStitch.com. Buy Online with delivery available Australia wide including Sydney.
Shared
Compose
From shaun.prescott@futurenet.com
To Dan Gardiner
Beer instead of work
Hi Dan,
Since it's so hot today, should be drink beer instead of making the magazine?
Weather
34°C in Waverton
Sunny - High 35° Low 26°
Precip 0%
Shared

AbiWord

Word process it up.

FREE | WWW.ABISOURCE.COM



All the excitement about VR and home assistants ignores the fact that most personal computing is still a matter of typing text with an input device of some kind, so we couldn't pass on the new version of AbiWord, a popular open-source text processor.

If you just need a tool for rich text formatting, AbiWord will do the job well. It has spelling and grammar check, collaborative document editing, decent OOXML support together with the industry-standard ODF format, image embedding and table editor. There are dozens of little helpers and timesavers hidden in it: from LaTeX-style equation input to the built-in look-up for selected text in Google and Wikipedia. It's solid, lightweight and based on GTK3 for compact Linux office workstations, where you need fast startup times and sensible RAM usage.

The last major release (v3) dates back to 2013, so we were extremely happy to see that the project is still alive. AbiWord used to suffer from various bugs, such as incorrect handling of GTK themes and occasional crashes, but the release notes of the new version claim that these have been fixed. AbiWord now runs better on Wayland and correctly prints SVG images as well.

If you feel that LibreOffice Writer is too heavy for your machine or maybe you just want to replace a bulky office suite with a smaller solution, give AbiWord a try. **Alexander Tolstoy**

NewBreeze

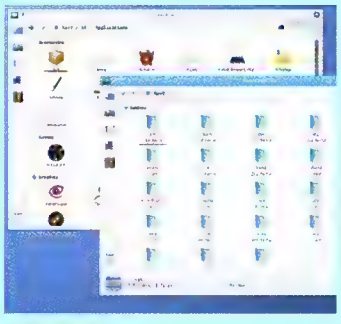
A versatile and feature-rich file manager.

FREE | BIT.LY/NEWBREEZE

Why on earth would you stick to Dolphin or Nautilus when there are so many alternatives? NewBreeze is Qt-based and has a peculiar design that differs from both orthodox twin-panel file managers (such as Krusader from issue 436) and classic managers such as Dolphin or PCManFM.

NewBreeze shows each file's size, type and permissions right in the main window, and for certain file types, it can show extra details, such as compression method for archives. You can show items in groups, change view mode, sort items by certain criteria — all within one or two mouse clicks.

The left side of the app has quick links to folders (the main view), applications, catalogues, devices and bookmarks. There are many design enhancements, such as the 'Peek' feature for quick folder previews, an in-line terminal with optional super-user mode, address bar with bread crumbs, auto-updated devices list and thumbnail support for most file types. NewBreeze is also a very convenient replacement for an application menu thanks to the dedicated list for your installed applications. You can customise the app in many ways, from changing default settings to enabling/disabling extra plugins or turning off its custom icon theme to make the application look a little nicer. **Alexander Tolstoy**



Darling

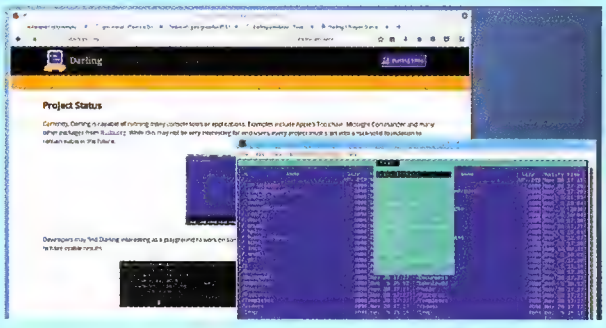
A Google Chromium-alike software emulator.

FREE | WWW.DARLINGHQ.ORG

Darling is a project that tries to add more compatibility between Linux and macOS by doing things in a similar way to Wine but for macOS apps. Darling already has the working software, but its capabilities are still very limited. It works by avoiding things like CoreCrypto, which enables the Apple's Security framework, which makes many open-source utilities (such as CMake) work in macOS.

Right now, you can use Darling to run a few supported command-line apps including Midnight Commander. Although there's probably no Darling package for your distro yet, you won't get lost compiling it from source code using the helpful build instructions on the project's website.

Once you're done compiling and inserting the kernel module, go ahead and issue the `$ darling shell` command. Immediately, you'll be taken to a containerised shell, which pretends as if it were a real macOS 10.8 environment. **Alexander Tolstoy**



PRO PC GEAR

ALL THE PERFORMANCE, NONE OF THE BLING: PROFESSIONAL-GRADE MONITORS, MICE, KEYBOARDS + STORAGE DEVICES ROUNDED-UP & EXPERT TESTED!

40
PRO MONITORS PUT TO THE TEST
We whip out the colourimeter to investigate and rate eight professional-grade LCDs.

50
THE KEYS TO PROFESSIONAL TYPING
Not happy with your ancient beige office 'board and need to step up your typing game? Here are 10 keyboards aimed specifically at pro users.

57
PROFESSIONAL MICE IN FOCUS
Not one of the gaming rat pack? We test five high-performance mice without the bling.

62
THE BEST TWO-BAY NAS BOXES
Backup basics covered! Need a personal NAS to back up your work? We test six.

Pro monitors put to the test

Josh Collins whips out the colourimeter to investigate and rate eight professional-grade LCDs.

For many people, when they see the price of professional-orientated monitors, they first need to pick their jaw up from the ground because of price-shock. This is especially common when in the smaller 24- to 27-inch ranges where bargains can indeed be had. Then they're left perplexed as to how or why these displays are so expensive!

They read the common specs; response time, refresh rate, panel size. They might even look at the panel type, too – at a basic level, at least. Essentially looking to see if the display uses an in-plane switching (IPS) technology-based panel because they've heard they're meant to look nice and view well. However, the majority of the time, they miss the point and just don't quite get it.

Does this sound familiar to you? Is this how you react or how one of your friends, family members or colleagues reacts? It's time to come into the fold and begin to understand the complicated, broad and deep world of digital colour reproduction.

For those of you in the loop already, we'll be looking at a range of colour-accurate displays across a broad spectrum of prices and specifications from leading brands in the marketplace.

A core aspect of what contributes so generously to the significant prices of professional-orientated displays is the ability to accurately and broadly reproduce many millions or even billions of colours. Not surprisingly, this is very important for professionals working in occupations that rely on being able to tell the difference between an emerald green and olive green, or perhaps the differentiation in shades of grey and minute details in dark images.

Welcome to the world of professional monitors.

Test bench specifications

- Intel Core i7-7700K
- Gigabyte Aorus Z270X-Gaming 7
- Nvidia GeForce GTX 1080 Founders Edition
- Micron 16GB (2 x 8GB) DDR4-2133
- Corsair Force LS 240GB SSD
- Corsair AX1200i
- X-Rite i1Display Pro

How we test (and how to set up) pro screens

A detailed guide to the steps and hardware involved in calibrating displays for professional use.

For most consumer-oriented monitors, subjective observations can provide enough information to make at least a rough assessment about the look, feel and general user experience of a given PC monitor. Products pitched at professional use are a slightly different kettle of fish, however, and purchase decisions are often made with a specific target in mind, with specs and features that need to hit specific goals in order to deliver the desired outcome for the user's chosen occupation.

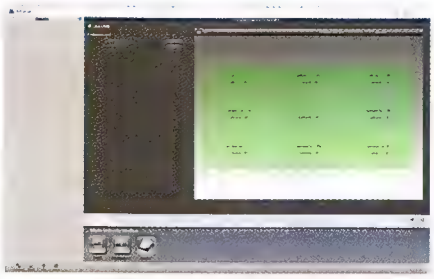
PRO SETUP

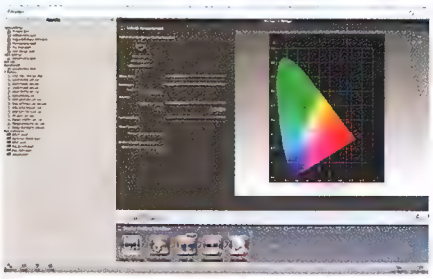
As such, to deliver the kind of objective information desired by the professional market, to calibrate displays for this feature, we used an i1Display Pro colourimeter developed by X-Rite, one of the two leaders in the professional colour calibration market – the other being Datacolor. The i1Display Pro is an upper-tier, professional model of colourimeter from X-Rite and inline with the Spyder 5 Elite by Datacolor. These devices are typically used by professionals to combat colour drift and colour misrepresentation, among many other elements of concern in expert colour management.

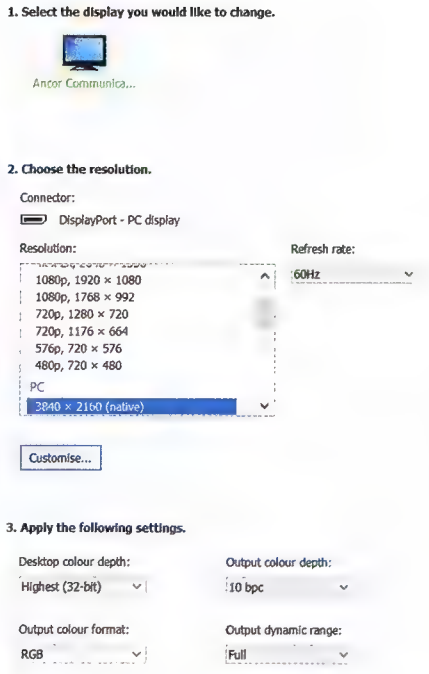
For pros or semi-pros looking for an economic option that lacks some of the more advanced, deeper, versatile settings, but still calibrates your display effectively for accurate colour, check out the ColorMunki Display by X-Rite along with the Spyder 5 Express and Spyder 5 Pro by Datacolor. These are still very capable colourimeters and will help to ensure your colours stay consistent throughout your workflow and digital workspace.

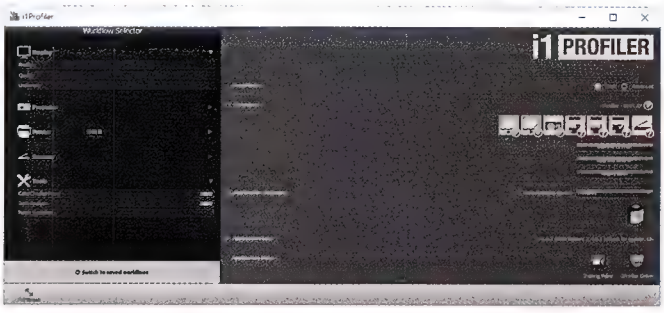
HOW COLOURIMETERS WORK

If you haven't heard of the i1Display Pro before, just what is it? It is a nifty little optical measurement device that fits with ease into the palm of your hand and is lightweight. The unit slings over your monitor with optics facing the display panel to measure the panel and has a few party tricks to get your display calibrated, just right. Paired with a software suite from X-Rite called i1Display Profiler, the i1Display Pro measures the display image outputs while you adjust settings in the display OSD such as brightness, contrast and RGB values, among others, to calibrate your display as close as possible to 'true' colour replication.









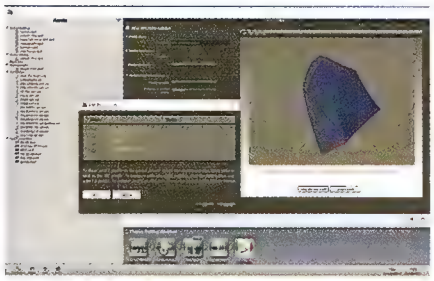
GETTING SET UP

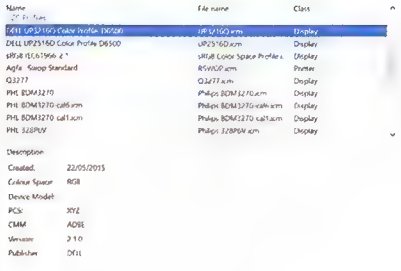
The i1Display Pro was connected to a host system via USB. In this case, the test bench is based on the new Intel Core i7-7700K with a Gigabyte Aorus Z270X-Gaming 7 and Nvidia GeForce GTX 1080 Founders Edition. The displays were connected via a DisplayPort connection and the displays set to receive a DisplayPort v1.2 signal to ensure sufficient bandwidth for the high resolution and high bit-depth displays to be tested.

Displays were factory reset upon setup and the colour profile set to user defined. Many of the displays feature a range of pre-set profiles, typically including sRGB and for some Adobe RGB, too. We ensured every bit of colour performance from the display unit was used throughout the benchmarking suite. This was achieved with a combination of using a hardware calibration device, setting a user defined colour profile on the display's OSD, and pairing both elements with the operating system colour profile generated through the i1Display Profiler software (ICM or ICC file depending on your system).

The benchmark suite checked numerous technical facets, which included luminance, contrast ratio, colour gamut, colour accuracy delta, panel uniformity and black levels.

This technical approach to monitor assessment ensures a thoroughly objective view of the performance delivered by the displays in the review roundup. Paired with the subjective user experience also assessed during the review process, the monitors were thoroughly put to the test.





$870 | WWW.AOCMONITORAP.COM/AU

AOC U3277PWQU

Stunning colour at a comparative bargain price.

The AOC U3277PWQU is fantastic value for money when considering the technical capability of this display. Though the availability within the market is scarce, with just one retailer listing the unit on Static Ice, but if you're happy to purchase from this retailer, it's a tremendous bargain.

Colour reproduction is vivid and immersive with a full 1.07 billion colour range replicated by the 10-bit panel. Colours are deep and beautifully saturated – though not overly so. Blacks are vivid, with excellent levels of differentiation. Paired with a maximum Delta-E value measured below 1.0, there is no perceivable difference to the human eye between standard colour forms.

The U3277PWQU delivers a broad colour gamut that competes with displays over twice the market price of this AOC unit. While display uniformity could be improved, it's not the worst result and is inline with the middle of the pack in terms of benchmark results.

The swivel functionality is implemented as a turntable under the base with the monitor stalk itself having no movement. Though swivel isn't great, the tilt and pivot capabilities are as should be expected. OSD control buttons are also clunky.

DisplayPort and HDMI handle connectivity with the unit supporting v1.2 and v2.0 respectively. Though the display also supports DVI-D Dual Link and D-sub, these are merely backward compatibility options and for the most part useless as they won't deliver the resolution, bit depth and refresh rate, this display requires to excel.

Verdict

Great value for money, though lacking the premium feel of competitors

★★★★½

$1,499 | WWW.ASUS.COM/AU

ASUS ProArt PA328Q

ProArt for professional artists.

The PA328Q is part of ASUS's premium professional-orientated range. The display features a 10-bit capable 8-bit + Hi-FRC panel paired with a 12-bit lookup table (LUT). This combination results in gorgeous colour reproduction with a 1.07 billion colour range.

The OSD has the best control mechanism in the whole roundup thanks to the 5-way OSD navigation joystick. This feature alone should become an industry standard – it's brilliant! The 5-way joystick itself makes for the simplest OSD setup process of the roundup.

We would like to see ASUS reduce the visual footprint of the OSD in future, as the OSD crossed into the centre quadrant making calibration a hassle due to the black background of the OSD hitting the calibrator's optical sensor. This resulted in having to quit and re-engage the OSD copious times throughout the calibration process.

Connectivity features two DisplayPort v1.2 ports and three HDMI ports. It also features an integrated USB hub with five downstream connections: one USB 2.0 and four USB 3.0.

Specified to support the Adobe RGB spectrum, this is one of the core differences between the PA and PB series of ASUS displays, as well as a manufacturer-claimed Delta-E <2, which was replicated in testing with the maximum CIE2000 Delta-E value returned of 1.84. Featuring strong black levels, good colour accuracy and a maximum display uniformity delta of 9%, the PA328Q is ready to assist with colour accurate workloads.

Verdict

A worthy consideration for pros requiring Adobe RGB coverage, albeit with some compromise.

★★★★☆

$849 | WWW.ASUS.COM/AU

ASUS PB279Q

Tactical compromise delivers a capable display.

Representing the economic solution from ASUS, the PB279Q provides access to a 10-bit workflow utilising a direct 10-bit panel with a 10-bit LUT and positioned at a cheaper price. However, this comes with compromises in the display performance.

For example, the PB279Q has a CIE2000 Delta-E value of 2.35, good black levels as opposed to excellent or strong, and a maximum panel luminance uniformity delta of 14%. These step-backs are likely only to impact professionals who demand the highest fidelity and consistency in colour representation. For the majority of users, and most semi-professionals such as hobby photographers and graphic designers, these shortcomings will likely be overlooked, with the user still impressed by what they see on the display.

When it comes to connectivity, the PB279Q has a neat party trick. By fully utilising the display's 3,840 x 2,160-pixel Ultra HD resolution and four HDMI v1.4 connections, the PB279Q can display four unique 1,920 x 1,080 Full HD signals at once by dividing the display into four quadrants. The unit also features two DisplayPort v1.2 links in the form of one mini and one full-sized port.

The Ultra HD resolution encapsulate in a 27-inch form factor leads to a beautifully crisp high dpi of 163. This lends itself to beautifully stunning image representation at the native resolution; however, it will also require some operating system scaling to reduce eye strain by the user as the perception of visual elements shrink due to the high dpi.

Verdict

Fair performance with acceptable compromise.

★★★★☆

$599 | WWW.DELL.COM/AU

Dell UltraSharp UP2516D

Broad Adobe RGB coverage that needn't kill the hip pocket.

The Dell UP2516D can be summarised as the solution for professionals requiring exquisite colour reproduction without breaking the bank. While the 25-inch size may turn some people off as they have become accustomed to using large +27-inchers, the UP2516D certainly still has a place to be considered by pros looking at an upgrade.

Covering 99.5% of the Adobe RGB colour gamut, the UP2516D is bested only by its stable mate the UP3216Q and delivers exquisite colour reproduction. The wide gamut coverage is paired with a maximum luminance uniformity delta of 12% and offers good black levels.

In terms of connectivity, it is well equipped, sporting two DisplayPort v1.2 links in both mini and full-sized proportions, as well as a DisplayPort output link for MST daisy chaining. Joining these are two HDMI v2.0 ports and four USB 3.0 downstream links, supported by two USB 3.0 uplinks ensuring plenty of bandwidth.

The OSD navigation is simple and actioned with ease via front-mounted, touch-sensitive controls with the OSD itself presented in the lower right corner in a visually non-intrusive manner.

Presenting a low CIE2000 maximum Delta-E of 1.14, there is essentially no perceivable colour shift to the human eye.

Rounded out with a sturdy and fully featured stand in terms of pivot, swivel, tilt and height adjustment, the Dell UP2516D is ready to deliver impressive colours — however you may be positioned from the screen.

Verdict

Exceptional colour gamut coverage at a good price, albeit with reduced display size.

★★★★☆

$2,559 | WWW.DELL.COM/AU

Dell UltraSharp UP3216Q

A stunning monitor with an equally stunning price tag.

For many people, the price of this display will stun and leave them puzzled. These are typically the people that aren't informed by the needs and wants of the specific target market of the product. Even so, with tax incentives in mind for professional user purchases of this display, it's still a steep price.

Yet savvy buyers will note the regular sales on Dell's website that wipe a few hundred dollars off the price tag when buying direct. Even savvier buyers will be aware the unit can be had for about $1,800 in the IT channel market. Meaning there are options to get around what might be perceived as a cost barrier for this impressive display.

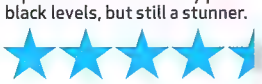
The UP3216Q boasts complete 100% Adobe RGB gamut coverage and is the only unit in the roundup to do so, though not without a premium. This coverage is achieved through the implementation of a 10-bit panel with a 16-bit LUT, delivering significant granularity to the 1.07 billion colours.

Though a little perplexed at first that this unit did not have OSD RGB adjustment, it proved unnecessary in both out-of-the-box colour replication and during colour calibration. The UP3216Q delivered a CIE2000 maximum Delta-E of 1.07 and extremely tidy display uniformity with the highest luminance delta a mere 2%! However, what we weren't impressed with were the black levels, delivering a poor result with only the 10th box in the black level test being distinguishable.

If it wasn't for the black levels, the UP3216Q would have ticked all the boxes for a professional display.

Verdict

Extremely capable colour reproduction let down by poor black levels, but still a stunner.



$1,388 | WWW.HP.COM/AU

HP Z34c

A curve-ball in this pro monitor roundup.

The HP Z34c is uniquely positioned as not just the only 21:9 aspect ratio display in this roundup but also the only curved display, too. This instantly creates an air of intrigue as one considers the proposition of owning such a display, opposed to the typical 16:9 flat displays.

From a benchmark scoring perspective, the Z34c returned fair results. This included good colour accuracy and, good black levels and a CIE2000 maximum Delta-E of 1.7.

However, these decent results are overshadowed by the poor display uniformity with a maximum luminance delta of 20% as both sides of the display blew-out from the values of the centre. This is an unfortunate side effect of the display's curved nature. As curved display technology is in its infancy, we hope this issue is resolved in future generations.

It's worth noting that another point of distinction for this display from the rest in the roundup is that it only supports 16.7 million colours through an 8-bit panel, something to be mindful of if you're wanting to operate with a 10-bit workflow. This said, the unit still claims support for 75% of the Adobe RGB colour gamut.

Bundled with a small remote control and featuring 2x 6W DTS certified speakers, it feels like this display is trying to cross over into the home entertainment segment, too.

We want to like the HP Z34c and appreciate some of its unique attributes, but for professional colour accurate use, there are better options available, especially for the asking price.

Verdict

Attention grabbing, but struggles to maintain interest from a professional perspective.

$753 | WWW.PHILIPS.COM.AU

Philips 328P6VJEB

Concerning lack of spec info for pros, but solid performer in the lab.

The 328P6VJEB proved a very capable display and returned positive results in testing, including excellent colour accuracy and black levels, and a CIE2000 maximum Delta-E of 1.4, showing its colour replication capability.

But when it comes to colour spaces, the Philips display specs are scarce on details. Specifically, there is no reference in any publicly available technical doc that states the sRGB percentage coverage and whether the unit covers Adobe RGB. Based on the 3D graphing of the colour profile we created with the i1Display Pro, it appears the unit potentially could. Further to this, when citing sRGB support, the documentation simply states 'Yes' – uh, OK.

We pushed Philips for answers and were informed sRGB 173.6% and Adobe RGB 101.9% – phwoah! Wait... They used CIE1931 to create these values. This is ridiculous considering CIE1931 was the first established algorithm to quantify and qualify non-digital colour. The digital colour reproduction standard wasn't introduced until CIE1976. Check the advanced info section for more CIE details, but basically Philips is trying to inflate its figures. Very poor form, Philips!

The display's physical attributes are likable, featuring great stand adjustability and sufficient connectivity with DisplayPort v1.2 and HDMI v2.0 support, along with DVI-D Dual Link and D-sub. But the DVI-D Dual Link and D-sub will go unused in order to hit panel specs and capability. The unit is topped off with a four-port USB 3.0 hub.

Verdict

Good performance, but be sure to calibrate so you're in an informed position for colour space.

★★★½☆

$549 | WWW.PHILIPS.COM.AU

Philips BDM3270QP2

Well priced, but leaves some important questions unanswered.

Based on specs, price point and test results, the Philips BDM3270QP2 appears to be a step down from the 328P6VJEB, which meets enough of the user requirements but not all of them and does so with a reduced price point.

In terms of performance, it was, for the most part, uninspiring. Characterised by merely acceptable display uniformity with a luminance delta high of 12%, good colour gamut coverage and good black level representation – this unit doesn't exactly stand out. That is, unless you're looking at the CIE2000 maximum Delta-E result – it had the highest at 2.45. But this isn't something to be proud of, especially within the scope a of professional usage scenario.

Oh, and sRGB is 'Yes'. Like the 328P6VJEB (left), spec details are scarce. Philips said sRGB 111% and Adobe RGB 82.2%... using CIE 1931 again. This inflates the gamut percentage values and results in useless info. Not acceptable, Philips!

Furthermore, testing revealed an oddity in that an accurate contrast ratio value could not be recorded during benchmarking.

The BDM3270QP2 uses the same well designed stand as its counterpart. The unit also shares similar connectivity, albeit with HDMI v1.4 instead of v2.0 and minus the USB 3.0 hub.

Backed by the lowest price point in the roundup, even with its shortcomings the BDM3270QP2 is a tempting proposition.

Our recommendation is that if you consider yourself a professional user, perhaps leave this one to the amateurs, lest you find yourself frustrated by the shortcomings.

Verdict

We wanted to like this one, but each time we find a reason to, there was another reason not to.

★★★☆☆

MONITOR SPECIFICATIONS

VENDOR:	AOC U3277PWQU	ASUS PA328Q	ASUS PB279Q	DELL UP2516D	DELL UP3216D	HP Z34C	PHILIPS 328P6VJEB	PHILIPS BDM3270QP2
PANEL SIZE:	31.5"	32"	27"	25"	31.5"	34"	31.5"	32"
PANEL TYPE:	AMVA	AHVA IPS	AHVA IPS	AH-IPS	IPS	SVA	VA	AMVA
PANEL BACKLIGHT:	W-LED	W-LED	W-LED	GB-R LED	W-LED	W-LED	W-LED	W-LED
PANEL BIT DEPTH:	10-BIT	10-BIT (8-BIT + HI-FRC)	10-BIT	10-BIT	10-BIT	8-BIT	10-BIT	10-BIT (8-BIT + FRC)
PANEL LUT:	10-BIT	12-BIT	10-BIT	N/A	16-BIT	N/A	N/A	12-BIT
FRAME RATE CONTROL (FRC):	NO	YES	NO	NO	NO	NO	NO	YES
PANEL MANUFACTURER:	INNOLUX	AU OPTRONICS	AU OPTRONICS	LG DISPLAY	N/A	SAMSUNG	N/A	AU OPTRONICS
PANEL MODEL:	M315DJJ-K30	M320Q001.V0	M270QAN01.0	LM250WQ2-SSA1	N/A	LTM340YP01	N/A	M320DVN01.0
REFRESH RATE:	60HZ	60HZ	60HZ	60HZ	60HZ	60HZ	60HZ	60HZ
MINIMUM RESPONSE TIME:	4MS	6MS	5MS	6MS	6MS	8MS	4MS	4MS
PANEL FINISH:	MATTE	MATTE	MATTE	MATTE	MATTE	GLOSS	MATTE	MATTE
REFRESH RATE:	60HZ	60HZ	60HZ	60HZ	60HZ	60HZ	60HZ	60HZ
MAX. LUMINANCE (CD/M2):	350CD/M2	350CD/M2	300CD/M2	300CD/M2	300CD/M2	350CD/M2	300CD/M2	300CD/M2
COLOURS:	1.07 BILLION / 30-BIT	1.07 BILLION / 30-BIT	1.07 BILLION / 30-BIT	1.07 BILLION / 30-BIT	1.07 BILLION / 30-BIT	16.7 MILLION / 24-BIT	1.07 BILLION / 30-BIT	1.07 BILLION / 30-BIT
ASPECT RATIO:	16:9	16:9	16:9	16:9	16:9	21:9	16:9	16:9
RESOLUTION:	3840 X 2160	3840 X 2160	3840 X 2160	2560 X 1440	3840 X 2160	3440 X 1440	3840 X 2160	2560 X 1440
PIXEL DENSITY:	139 PPI	137 PPI	163 PPI	117 PPI	139 PPI	109 PPI	139 PPI	91 PPI
STATIC CONTRAST RATIO:	3000:1	1000:1	1000:1	1000:1	1000:1	3000:1	3000:1	3000:1
HOR/VERT VIEW ANGLES:	178°	178°	178°	178°	178°	178°	178°	178°
SRGB GAMUT COVERAGE:	100%	100%	100%	100%	100%	98.80%	N/A	N/A
ADOBERGB ('98) GAMUT COVERAGE:	N/A	77%	N/A	100%	99.50%	75%	N/A	N/A
RGB COLOUR ADJUSTMENTS:	YES	YES	YES	NO	NO	YES	YES	YES
TESTED GAMUT COVERAGE SIMILARITY:	GROUP 1	GROUP 2	GROUP 2	GROUP 1	GROUP 1	GROUP 2	GROUP 1	GROUP 2
VESA MOUNT:	YES, 100MM	YES, 100MM	YES, 100MM	YES, 100MM	YES, 100MM	YES, 100MM	YES, 100MM	YES, 100MM
REMOVABLE STAND:	YES	YES	YES	YES	YES	YES	YES	YES
HEIGHT ADJUSTMENT:	YES	YES	YES	YES	YES	NO	YES	YES
LANDSCAPE-PORTRAIT PIVOT:	YES	YES	YES	YES	NO	NO	YES	YES
LEFT PIVOT:	0°	0°	90°	90°	-	-	0°	0°
RIGHT PIVOT:	90°	90°	0°	0°	-	-	90°	90°
LEFT-RIGHT SWIVEL:	YES	YES	YES	YES	YES	NO	YES	YES
LEFT SWIVEL:	165°	60°	60°	45°	30°	-	170°	170°
RIGHT SWIVEL:	165°	60°	60°	45°	30°	-	170°	170°
FORWARD TILT:	5°	5°	5°	5°	4°	5°	5°	5°
BACKWARD TILT:	24°	20°	20°	21°	21°	25°	20°	20°
SPEAKERS:	2 X 3W	2 X 3W	2 X 2W	NO	NO	2 X 6W DTS	2 X 3W	2 X 3W
CONNECTIVITY								
DISPLAYPORT:	1	1	1	1	1	1	1	1
MINI-DISPLAYPORT	-	1	1	1	1	-	-	-
DISPLAYPORT VERSION:	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
DISPLAYPORT MST (OUTPUT):	-	-	-	1	1	-	-	-
HDMI:	1 (MHL)	3 (1X MHL)	4 (4X MHL)	2 (2X MHL)	1 (MHL)	2 (1X MHL)	1 (MHL)	1 (MHL)
HDMI VERSION:	2.0	1.4 (X2) AND 2.0 (X1)	1.4	2.0	2.0	1.4	2.0	1.4
DVI-D DUAL LINK:	1	-	-	-	-	-	1	1
D-SUB:	1	-	-	-	-	-	1	1
3.5MM AUDIO IN:	1	-	1	1	-	-	1	1
3.5MM AUDIO OUT:	1	1	1	1	1	1	1	1
USB 2.0 DOWNSTREAM:	-	1	-	-	-	-	-	-
USB 3.0 UPSTREAM:	-	1	-	2	1	1	1	-
USB 3.0 DOWNSTREAM:	-	4	-	4	3	2	4	-
SD MEMORY CARD SLOT:	-	-	-	-	1	-	-	-
OVERALL APC LAB SCORE:	4.5	4	4	4	4.5	2.5	4	3.5

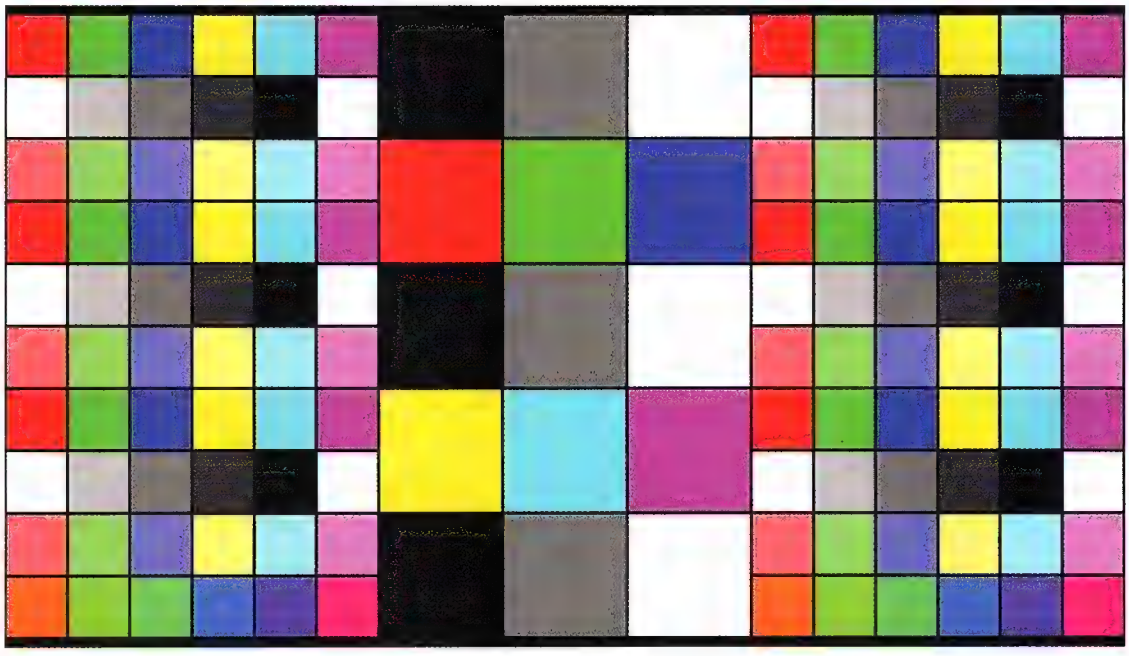
MONITOR TEST RESULTS

MODEL	AOC U3277PWQU			ASUS PA328Q			ASUS PB279Q		
LUMINANCE (CD/M2)	248			298			127		
CONTRAST RATIO	2744:1			905:1			521:1		
COLOUR ACCURACY	EXCELLENT			GOOD			GOOD		
CIE1976 AVG DELTA-E	0.65			1.34			1.02		
CIE1976 MAX DELTA-E	1.51			3.28			4.76		
CIE2000 AVG DELTA-E	0.43			0.82			0.66		
CIE2000 MAX DELTA-E	0.95			1.84			2.35		
BLACK LEVELS SUMMARY	EXCELLENT			STRONG			GOOD		
FIRST FULLY DISTINGUISHABLE BLACK LEVELS BOX	1			2			4		
HIGHEST LUM. DELTA	15%			9%			14%		
DISPLAY UNIFORMITY & LUMINANCE DELTA (WHITE: 255, 255, 255)	LD: 15% LUM: 210	LD: 8% LUM: 227	LD: 3% LUM: 244	LD: 5% LUM: 280	LD: 7% LUM: 276	LD: 9% LUM: 270	LD: 9% LUM: 113	LD: 7% LUM: 116	LD: 12% LUM: 109
	LD: 12% LUM: 217	LUM: 248	LD: 2% LUM: 254	LD: 2% LUM: 289	LUM: 297	LD: 8% LUM: 272	LD: 7% LUM: 116	LUM: 125	LD: 11% LUM: 111
	LD: 12% LUM: 217	LD: 7% LUM: 230	LD: 0% LUM: 247	LD: 4% LUM 285	LD: 5% LUM: 280	LD: 8% LUM: 273	LD: 6% LUM: 117	LD: 12% LUM: 110	LD: 14% LUM: 107

MODEL	DELL UP2516D			DELL UP3216Q			HP Z34C		
LUMINANCE (CD/M2)	204			171			224		
CONTRAST RATIO	1051:1			616:1			1574:1		
COLOUR ACCURACY	EXCELLENT			EXCELLENT			GOOD		
CIE1976 AVG DELTA-E	0.66			0.61			0.78		
CIE1976 MAX DELTA-E	1.3			1.42			3.88		
CIE2000 AVG DELTA-E	0.41			0.39			0.48		
CIE2000 MAX DELTA-E	1.14			1.07			1.7		
BLACK LEVELS SUMMARY	GOOD			POOR			GOOD		
FIRST FULLY DISTINGUISHABLE BLACK LEVELS BOX	4			10			4		
HIGHEST LUM. DELTA	12%			2%			20%		
DISPLAY UNIFORMITY & LUMINANCE DELTA(WHITE: 255, 255, 255)	LD: 5% LUM: 192	LD: 7% LUM: 188	LD. 10% LUM: 183	LD: 1% LUM: 173	LD: 0% LUM: 170	LD: 1% LUM: 174	LD: 18% LUM: 183	LD: 9% LUM: 203	LD: 20% LUM: 178
	LD: 5% LUM: 192	LUM: 204	LD: 7% LUM: 189	LD: 0% LUM: 172	LUM: 171	LD: 1% LUM: 174	LD: 16% LUM: 186	LUM: 224	LD: 16% LUM: 188
	LD: 10% LUM: 183	LD: 11% LUM: 180	LD: 12% LUM: 178	LD: 1% LUM: 174	LD: 0% LUM: 172	LD: 2% LUM: 175	LD: 17% LUM: 184	LD: 7% LUM: 207	LD: 15% LUM: 190

MODEL	PHILIPS BDM3270QP2			PHILIPS 328P6VJEB		
LUMINANCE (CD/M2)	243			185		
CONTRAST RATIO	DNF*			2227:1		
COLOUR ACCURACY	GOOD			EXCELLENT		
CIE1976 AVG DELTA-E	0.83			0.65		
CIE1976 MAX DELTA-E	6.06			1.43		
CIE2000 AVG DELTA-E	0.52			0.49		
CIE2000 MAX DELTA-E	2.46			1.4		
BLACK LEVELS SUMMARY	GOOD			EXCELLENT		
FIRST FULLY DISTINGUISHABLE BLACK LEVELS BOX:	4			1		
HIGHEST LUM. DELTA:	12%			13%		
DISPLAY UNIFORMITY & LUMINANCE DELTA(WHITE: 255, 255, 255):	LD: 1% LUM: 240	LD: 2% LUM: 238	LD: 5% LUM: 230	LD: 10% LUM: 165	LD: 6% LUM: 172	LD: 2% LUM: 179
	LD: 4% LUM: 234	LUM: 244	LD: 9% LUM: 220	LD: 11% LUM: 162	LUM: 184	LD: 2% LUM: 179
	LD: 6% LUM: 228	LD: 9% LUM: 222	LD: 12% LUM: 214	LD: 13% LUM: 159	LD: 6% LUM: 172	LD: 5% LUM: 173

DNF* = unreliable result of -2147483648:1 consistently returned by i1Display Pro calibration hardware with i1Display Profiler calibration software.



Advanced digital colour know-how

A deep dive into the ins and outs of how colour reproduction is handled in the digital realm.

One of the first things to understand about colour is that it is very difficult to replicate what the human eye sees. Technology does its best, but at the end of the day, mother nature still trumps with the ability to create and perceive minute, unique differences in all aspects of colour – contrast, hue, saturation, gamma, brightness and gamut, to name a few components.

Accurate representation and replication of colour is hugely important for professionals working in colour-sensitive occupations. Proper calibration is necessary to avoid scenarios where what was seen on-screen doesn't match up with reality.

STANDARDS & SPECS

There are a few big players that define the technical aspects of colour reproduction. The two most prominent are the Commission internationale de l'éclairage (International Commission on Illumination, known as CIE for short) and the International Colour Consortium, abbreviated to the ICC.

To give a brief overview, the ICC outlines and characterises the way colour is input or output by devices – for example, a digital camera, display or printer – and defines these specifications as a colour space. A colour space can then be applied throughout a workflow – i.e. the aforementioned devices inter-relating to achieve the colour-processing goal, in order to effectively and truthfully replicate the colour from start-point to end-point.

On the other hand, the CIE defines the algorithms that are used to depict, define and replicate colour throughout the broad spectrum of devices and colour related spaces. The term 'colour space' is used due to the CIE defining colour in a three-dimensional six-axis graph. This 3D depiction of colour was first established in 1976 and the standard called CIE1976 was born, often shortened to CIE76.

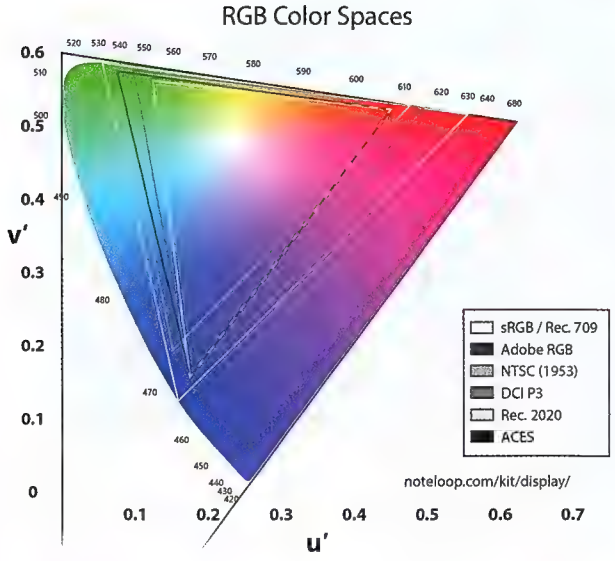
As colour replication and representation developed, so did the need to deal with different saturation levels, as well as weighting factors for each lightness, chroma and hue value within the CIE algorithm. The defining algorithm was updated in 1994 as CIE1994, or CIE94 for short, and again in 2000 – you bet, it's called CIE2000 and CIE00 for short. Each update of the CIE algorithm allowed for further delineation between different elements within the algorithm that ultimately define colour, allowing for greater granularity and gradation across the aspects of colour.

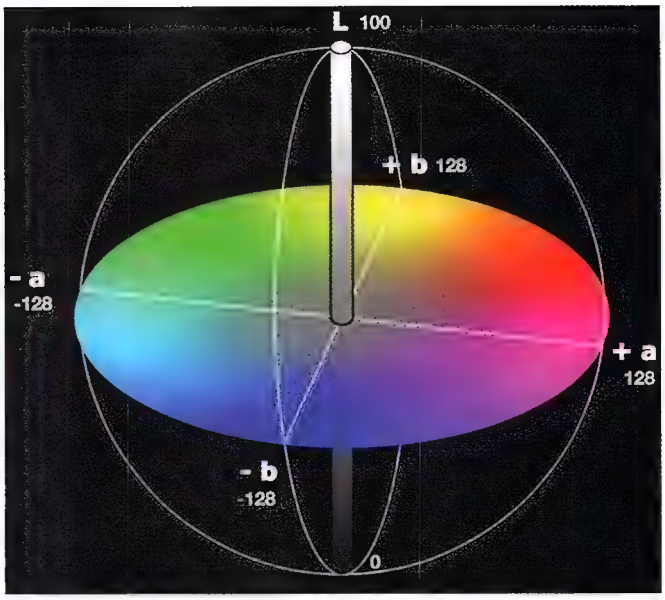
NOTHING IS REDUNDANT

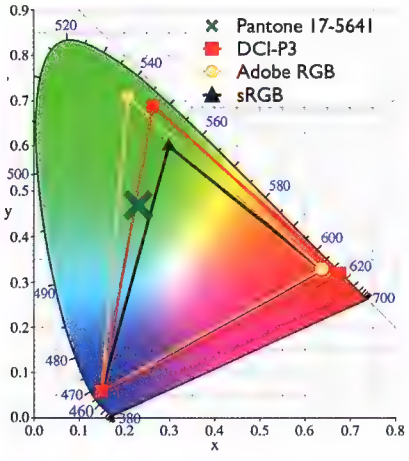
However, these differing CIE standards are still at play today. For example, the i1Display Profiler provides luminance data for both CIE1976 and CIE2000. Data from both of these standards has been included in the benchmark test results listed to demonstrate the difference between the two.

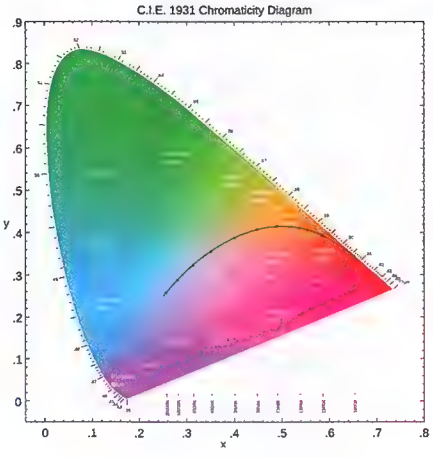
Comparing CIE76 and CIE00, there are significant differences in values due to the significant differences in the defining algorithms. Now consider the fact that numerous vendors in the roundup had an A4 printed paper with factory calibration results printed (common for colour accurate products), and the majority were using CIE94 as the standard algorithm for assessment. Comparing values from different CIE standards is irrelevant.

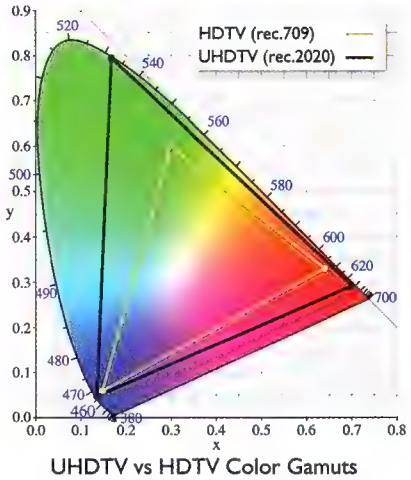
This crossover of CIE standards creates a headache for comparing values and can make some comparisons useless. When a display vendor claims 'Delta-E <2', it's important to understand what CIE standard was used to ensure fair comparison. And most of the time, vendors don't openly list the CIE











UHDTV vs HDTV Color Gamuts

standard used for assessment. This can create an obvious headache and is part of the reason we've done this roundup for you.

BIT-DEPTH & GAMUT

Another important aspect of digital colour reproduction is colour bit-depth and gamut. The bit-depth will define the colour range that can be replicated while the gamut is the granularity of the colour changes within the range.

There are numerous gamut standards, some you would likely have seen mentioned such as sRGB or Adobe RGB, while there are other emerging gamut standards such as DCI-P3, Rec. 709 and Rec. 2020.

From 8-bit colour, we get over 16.7 million colours while 10-bit delivers 1.07 billion colours. The more colours that a display can replicate, the more colours that can be replicated within the digital pipeline and with it the gamut available (ie. increased granularity of colour). Some panels have a neat trick whereby an 8-bit range is implemented but by also using Frame Rate Control (FRC) with spatial dithering, the range can be boosted to replicate 10-bit, i.e. boosting from 16.7 million to 1.07 billion colours.

However, don't think that you will perceive 1.07 billion colours by simply using a 10-bit display panel, because if the rest of the pipeline is using 8-bit lookup tables (LUTs), then the 10-bit panel will just be showing the 16.7 million colours from the 8-bit pipeline.

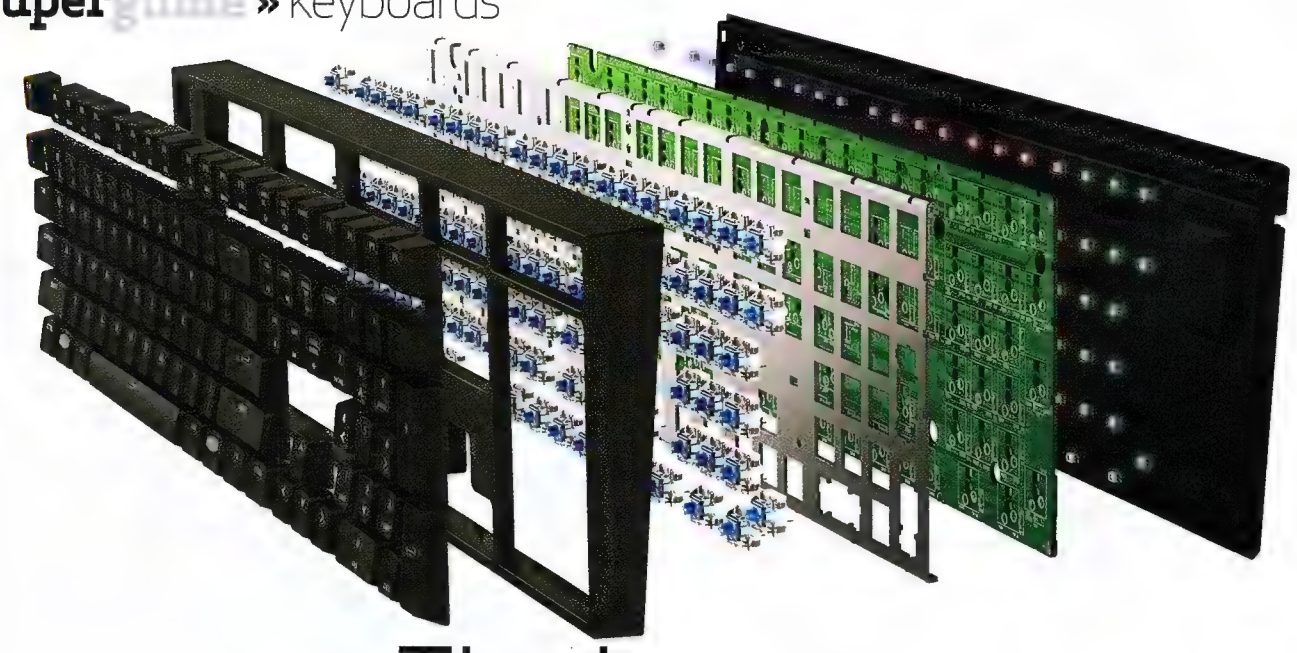
EVERY LINK IN THE CHAIN

The graphics pipeline refers to the process of generating an image – the source – and then replicating this source on the output, such as a PC display, projector or printer. The generation of the image occurs in what is known as an API. We won't be getting into the nitty-gritty of APIs, but when it comes to digital creative colour workflows, there are typically three APIs – Direct-X (DX), OpenGL and OpenCL.

Numerous programs to facilitate colour communication and replication use the APIs. For example, your favourite video games typically use Direct-X while creative production applications such as Adobe's Creative Suite (Photoshop, Illustrator, Premier Pro, Lightroom, After Effects and so on), Maxon's Cinema4D or AutoDesk's 3ds Max can take advantage of OpenGL and OpenCL.

Looping back to the 10-bit workflow and considering APIs, this is where hardware selection becomes important for creators desiring to work in a 10-bit workflow. This is because the Nvidia GeForce GTX series graphics cards only support 10-bit colour processing in Direct-X and are locked down on a driver level to not support OpenGL or OpenCL. If you wish to have this support, you will need to purchase a professional-orientated product such as the Nvidia Quadro series.

The flip side of this is that both the consumer (Radeon) and professional (Radeon Pro, formerly FirePro) graphics card offerings from AMD support 10-bit colour processing across Direct-X, OpenGL and OpenCL regardless of which tier of GPU is used. Be mindful of this when making your purchase decision with a 10-bit workflow in mind. ■



The keys to professional typing

Not happy with your ancient beige office 'board and need to step up your typing game? Josh Collins rounds up 10 keyboards aimed specifically at pro users.

There are many reasons to be dissatisfied with the generic keyboard that many professionals use in day-to-day digital work life. We've certainly been there too, and it's not fun. It's not uncommon for the office-bound to have to deal with crusty old keyboards with all manner of biological hazards left behind thanks to having done the rounds through years of service.

Perhaps your desk space is limited and the giant keyboard you're using is simply creating an unnecessarily fussy workflow. Maybe you suffer from keyboard induced RSI and general muscle strain from poor ergonomics. Whatever the reason, there are good alternative options out there – so you needn't suffer any longer. Whether you're looking to pitch an office purchase to your boss or happy to throw down some of

KEYBOARD SPECIFICATIONS

VENDOR	MARKET PRICE	KEY SWITCH TYPE	INTERFACE	KEYBOARD TYPE	KEY COUNT	POSITIVE TILT	NEGATIVE TILT	TENT TILT
AZIO MK RETRO	$179	MECHANICAL	USB	FULL	104	YES	NO	NO
COOLER MASTER MASTERKEYS PRO L RGB	$189	MECHANICAL	USB	FULL	104	YES	NO	NO
DAS KEYBOARD MODEL S PROFESSIONAL	$215	MECHANICAL	USB (X 2)	FULL	104	YES	NO	NO
DAS KEYBOARD ULTIMATE 4C TKL	$195	MECHANICAL	USB	TENKEY-LESS (TKL)	87	YES	NO	NO
FILCO MAJESTOUCH CONVERTIBLE 2 BT	$259	MECHANICAL	USB	FULL	104	YES	NO	NO
IKBC F87 RGB	$169	MECHANICAL	USB	TENKEY-LESS (TKL)	87	YES	NO	NO
IKBC F108 RGB	$179	MECHANICAL	USB	FULL	108	YES	NO	NO
MATIAS ERGO PRO	$299	MECHANICAL	USB	SPLIT ERGONOMIC	87	YES	YES	YES
MICROSOFT NATURAL ERGONOMIC KEYBOARD 4000	$59	DOME CAP	USB	FULL ERGONOMIC	117	YES	YES	NO
STEELSERIES PRO GAMING 6G V2	$130	MECHANICAL	USB	FULL	104	YES	NO	NO

your own hard-earned cash to enjoy that familiar keyboard touch like your home setup, it's best to first be informed. To help you discover and understand some of the popular options on the market, as part of this pro gear superguide we've rounded up a collection of keyboards that should appeal to more professional senses.

And as technology enthusiasts and technology journalists, the people behind *APC* certainly appreciate a good keyboard – typing many thousands of words each month tends you make you a but fussy like that, so let's get to it.

WHAT'S IN A NAME?

To start, though, let's define what a 'professional keyboard' is, precisely. The defining features of a professional keyboard can change depending on your line of work, your specific needs and any personal preferences you may have developed over the years of computer use; specifically keyboard use. Like mice, keyboards are no longer basic human input devices and carry numerous special features. These features can also cross over into other specific use cases. This leads us to the plethora of gaming keyboards on the market – but can they be used for office use? And if so, how or why might they be suitable?

Let's first accept the fact that, while gaming-orientated features are numerous, they aren't always gaming-specific and can have strong benefits for office use. One such example is a gaming feature called NKRO, or 'N-key rollover', for those not down with the naff lingo. While this feature is, for the most part, ubiquitous across gaming mechanical keyboards, it its purpose is to provide a signal buffer and is therefore great for speedy touch typists that can hit the keys faster than the message can get through to the computer.

Another feature often lauded for gaming is key illumination. However, this certainly has a place in the office, too. It's great for those you're working in less-than-ideal lighting conditions and can also just make it easier to perceive the keys for those who aren't touch typists. Many people will have become accustomed to illumination through laptop use, too, so it's natural to want to have that extended to a full-sized desktop board too.

For this feature, we've defined a professional keyboard as a unit that facilitates and promotes productivity, allowing for prolonged use with comfort and speed – and having the subdued styling that's appropriate for an office environment.

THANKS TO MWAVE

As with the mouse roundup (starting on page 57), we'd like to extend our thanks to Aussie tech retailer Mwave (**www.mwave.com.au**) for helping to supply some of the review samples for this roundup.

CABLE LENGTH	BRAIDED CABLE SLEEVE	DETACHABLE CABLE	WEIGHT	DIMENSIONS	DUST COVER	MEDIA CONTROLS	ILLUMINATION	USB 2.0 HUB	WARRANTY
1.8M	YES	NO	1.04KG	455 X 147 X 40MM	YES	YES	NO	NO	2 YEAR LIMITED WARRANTY
1.5M	YES	YES	1.09KG	439 X 130 X 42MM	NO	YES	RGB	NO	2 YEAR LIMITED WARRANTY
2.0M	NO	NO	1.36KG	457 X 165 X 38MM	NO	YES	NO	YES, 2 PORTS	1 YEAR LIMITED WARRANTY
2.0M	NO	NO	0.9KG	394 X 154 X 36MM	NO	YES	NO	YES, 2 PORTS	1 YEAR LIMITED WARRANTY
1.9M	NO	YES	1.2KG	440 X 138 X 39MM	YES	YES	NO	NO	1 YEAR LIMITED WARRANTY
1.8M	YES	NO	1.1KG	358 X 136 X 42MM	YES	NO	RGB	NO	1 YEAR LIMITED WARRANTY
1.8M	YES	NO	1.25KG	439 X 136 X 42MM	YES	YES	RGB	NO	1 YEAR LIMITED WARRANTY
2.0M	NO	YES	1.69KG	368 X 230 X 35MM (X 2)	NO	YES	NO	YES, 3 PORTS	1 YEAR LIMITED WARRANTY
1.53M	NO	NO	1.3KG	503 X 262 X 83MM	NO	YES	NO	NO	3 YEAR LIMITED WARRANTY
1.9M	NO	NO	1.2KG	480 X 250 X 43MM	NO	YES	NO	NO	1 YEAR LIMITED WARRANTY

$179 | WWW.AZIOCORP.COM

Azio MK Retro

Retro styling meets modern technology, but does it work well?

Themed on the visual design of an old-school typewriter, the Azio MK Retro is a clash of past and present. Certainly unique in its aesthetic, the simple fact is that it's not going to be to everyone's liking.

Some will see charm while others will roll their eyes back as they mutter "hipster" under their breath moments before asking if you still wanted that Grande, iced, sugar-free, vanilla latte with soy milk. Whichever side of the coin you fall on, there's no doubting the unit would be a conversation starter for the first week or so of office use. Or whenever someone from another floor visits and stops mid-step.

Aesthetics aside, the unit tries its hardest to tick many of the do-want boxes for an office replacement keyboard. It features multimedia hot keys, sports a familiar layout and mechanical switches that aren't too obnoxiously loud – though still a bit clicky and could get on the nerves of a workmate.

If you enjoy touch typing, you may want to think long and hard about whether the aesthetics are worth the functional limitations. Though the unit has an elevated stand setting, it still doesn't feel like it's steep enough. This could be due to the flat nature of the keys and lack of gradated alignment within the keyboard's casing. You'll also find that, as you slide from key to key, your fingers are clipping the edge of keys as you move from a depressed key to strike another.

We find the looks charming, but the impact on core functionality becomes frustrating quickly.

Verdict

For the price, there are more functional options to consider. But if looks matter, it's a charmer.

$189 | WWW.COOLERMASTER.COM

Cooler Master MasterKeys Pro L RGB

CM delivers the goods without overdoing it.

Many pros might think twice about using a gaming-orientated keyboard for office use, but in today's market, it is the gaming keyboards that garner the majority of the vendor focus – and, therefore, innovation and development with it. This has paved the way for all sorts of updates to the humble keyboard and an explosion of 'gaming' keyboard products on the market. But it's not just about gaming, and the Cooler Master MasterKeys Pro L RGB nails it.

Featuring subdued, minimalistic industrial design that could see the MasterKeys Pro L RGB overlooked by many, especially in an office environment – this unit is a gaming ninja. We see this as nothing but a positive. Even more so considering the focus of professional application. Should you choose to give it a little flare – or a lot – then you can do so with the RGB backlight illumination. This offers a variety of styles that could be described as playful, static, dynamic, pretty and, for some perhaps, even distracting.

The Pro L RGB features numerous function hot keys that cover lighting, key repeating, macros, multimedia, profiles, Windows key lock and even LED recording for when you've got a moment to burn.

Bundled with a software suite for refined setup, if your workplace has a strict IT policy not allowing software installation, worry not, as four profiles can be saved to the keyboard.

Verdict

This subdued unit, pitched for gaming, goes for office gold and hits home in a big way.

$215 | WWW.DASKEYBOARD.COM

Das Keyboard Model S Professional

An expensive keyboard, but so nice.

Das Keyboard was one of the first modern mechanical 'boards to capture the eye of the enthusiast and now has earned a reputation for developing and releasing keyboards that tick many users' 'want' boxes for functionality and form. With a minimalistic, simple approach to keyboard implementation, Das Keyboard aptly applies the KISS principle – 'keep it simple stupid'.

The notoriety within the market has also earned Das Keyboard a price premium over similar specced mechanical keyboards. At times, this can be hard to justify given the Das Keyboard Model S Professional lacks features such as key illumination, a detachable cable, a dust cover and only a one-year limited warranty.

But to its credit, the Das Keyboard offerings are two of only three keyboards in the roundup to feature a USB hub, albeit USB 2.0 spec.

For all the highlighting of short comings, there is no denying the Das Keyboard Model S Professional simply feels right. The review unit sampled for review featured Cherry MX Blue switches which are a favourite, though noisy and, therefore, not the greatest for many close-quarter office spaces. Fear not, Cherry MX Brown switches are also available for a less audible typing experience.

Part of what makes the Model S Professional so enjoyable to type on is the attention to key shape, spacing and level gradation. It simply works well and, for that reason alone, you may choose to accept the premium price.

Verdict

Pricey but if you know what you want, and this is it, then price won't likely stop your purchase.

★★★★½

$195 | WWW.DASKEYBOARD.COM

Das Keyboard Ultimate 4C TKL

Don't be blindsided by this keyboard's unique traits.

The Das Keyboard Ultimate 4C, like it's stablemate, the Model S Professional (left), is a joy to type on. The standout difference with this keyboard is the complete lack of any key surface inscriptions. And we mean *any*. This keyboard is as nude as you were the day you were born. For some, this will be a confronting and possibly deal-breaking feature. For others, they will revel in the difficulty it causes workmates and will undoubtedly get a laugh or two out of the scenario in the process.

The 4C Ultimate sports a tenkeyless design – or TKL for short – and, therefore, also features a diminutive size by comparison with most of the other keyboards in this roundup. This TKL style isn't for everyone, but for those that enjoy the smaller footprint and don't miss the numpad and other keys found to the right of the keyboard, it's a plus.

Also scoring positively, much like the Model S Professional (left), is the typing experience. It feels good. Real good. Even though this unit sports switches by Greetech, and not Cherry which boasts the most well-known and famed name in mechanical switches, the Greetech switches deliver the goods.

The party trick of the 4C Ultimate is found on the back. The stand that props up the keyboard to a comfortable angle is magnetically attached and can detach to double as a ruler, complete with measurements. Well played, German engineering. In the office, this means no-one will steal your ruler again. And if they do, just ask for part of your keyboard back!

Verdict

A neat TKL unit with intriguing attributes that complement well. No-one will yoink your keyboard!

★★★★½

$259 | WWW.DIATEC.CO.JP/EN

Filco Majestouch Convertible 2 BT

Vroom-vroom! There are systems to connect to and work to be done!

Filco was one of the first truly present players in the revival of the mechanical keyboard market alongside Das Keyboard. Coming directly from the professional market space and capturing the hearts of many gamers, the Filco Majestouch 2 Convertible BT continues the legacy of delivering great keyboard performance.

As the most expensive keyboard in the lineup at $259, the price could be a difficult pill for some to swallow. However, with the non-Bluetooth enabled model coming in at $219, one can start to see an argument for value in this top-of-the-range keyboard if Bluetooth connectivity is in focus when making the purchase decision. This is due to the ability to not only connect via Bluetooth to a device, but being able to connect to four – yes, four –Bluetooth-enabled devices at once and toggle effortlessly between the devices with a simple function-key stroke. Like the Das Keyboard Model S Professional (back over the page) – this unit's closest competitor – the 2 BT also features Cherry MX mechanical switches and is available in a range of switch types/colours. However, unlike the Das Keyboard offerings, the Filco doesn't feature a USB hub integrated into the keyboard chassis.

Though expensive when looking purely at dollar value, the Majestouch Convertible 2 BT claws back some perception of value with its broad Bluetooth connectivity.

Yet, if you won't use this feature, you're back to questioning the price – regardless of how good it feels when typing.

Verdict

Flexible connectivity is a winner for those operating multiple devices in an office space.

$169 | WWW.IKBC.COM.TW

IKBC F87 White RGB

A little sprite in white.

When considering the thought of reviewing a white keyboard there was something we wanted to know straight away: does it get grubby and, if so, how easily does it clean up?

To that end, when coordinating the test sample with Mwave, we specifically requested if there was a unit available that had seen some use. Bingo! Mwave provided the demo unit from the shop showroom which had been through about nine months of use – great!

Was the unit grubby? Naturally – it's a white-surfaced object which requires tactile interaction. Further to that, the unit had seen public use in a showroom, seemingly worked over by the masses. To its credit, after a quick wipe down with a wet-wipe, the unit had lost its brown tinge and was once again pristine white.

Next, intrigued by how this demo unit would compare to the brand new, in box non-TKL unit, we set about bashing out some words for this issue. To our satisfaction, the keys, and with them the switches, felt just like the new non-TKL model when it was taken out of the box. With this, we know the iKBC F87 White RGB can deliver with durability and maintain ongoing functionality, even when unloved by one and used by many.

Pairing the tried and tested Cherry MX switches (Blue/Black/Brown/Red) for smooth, effortless typing with driverless illumination and other feature support, the iKBC F87 White RGB is ready to plug and play... I mean, work.

Verdict

Well rounded, durable and simple, left wanting only for multimedia controls.

$139 | WWW.IKBC.COM.TW

IKBC F108 Black RGB

Unassuming looks, first-rate performance.

If confronted with the choice between the iKBC F108 Black RGB or the Azio MK Retro (page 52) – both are positioned at the $179 price point – for us, it's a no-brainer. We'd pick the iKBC every time.

For starters, it feels good when touch typing with no issue from the first stroke onwards, unlike the Azio. All-key RGB illumination functionality is also built into the keyboard firmware and, therefore, requires no drivers for complete functionality. In office environments where the IT team might run a tight ship and lock out non-power users from installing software, the firmware advantage plays true.

Furthermore, the granularity of the RGB colour shifting (function key + F1–F3) across seven stages – off plus six levels of luminance – provides flexibility across lighting hue and intensity. Again, without need for software and driven by firmware.

Featuring the extra length and keys missing from the TKL variant (left), the extra functionality will be welcomed by those that spend significant time processing numbers. The top row function keys also provide dedicated volume control buttons, as well as a unique 'Cal' button which opens up calc.exe in Windows.

A fairly hefty keyboard weighing in at 1.25kg, yet due to the minimalist design, the unit doesn't present itself as bulky either visually or physically.

Though the Black RGB unit is the sample tested, if you like the colour of the TKL variant but want the numpad, worry not – the iKBC F108 White RGB is also available.

Verdict

An accomplished keyboard that doesn't overcomplicate and does what it does well.

$299 | MATIAS.CA

Matias Ergo Pro

Definitely unique, but not always in a good way.

Ergonomics can deliver some peculiar oddities to the market and the Matias Ergo Pro is certainly one of them. With a unique design to say the very least, the Ergo Pro will test your boundaries both in terms of what you consider a normal keyboard, as well as its general setup.

Versatility dressed by options is how we describe the Matias Ergo Pro to colleagues bewildered by the unusual form. The only keyboard in the roundup to feature the full trio of negative and positive tilt options paired with the ability to initiate a tent form. This opens numerous options for differing ergonomic implementations.

In terms of core function, the Ergo Pro does well, not requiring a significant amount of time to adjust to the unusual setup. This is welcomed by those uninitiated to the split-hand typing method, though like the Microsoft Ergo 4000 (see page 68), some self-taught touch typists may find themselves hitting a function key with their right hand when hunting for the B key, which actually resides on the left keypad.

Complete with mechanical key switches, the Matias Ergo Pro delivers a reasonable touch when typing, though not on the same level as the likes of the Das Keyboard, Filco, CoolerMaster or iKBC offerings. And you pay for it.

The Ergo Pro isn't just trying to make life easier with ergonomics, it also delivers dedicated function keys for one-stroke undo, cut, copy and paste. The icing on the cake is that the functionality is incorporated via firmware and requires no drivers to work.

Verdict

Unusual in both form and function, the Ergo Pro isn't for the faint hearted — especially at this price!

$59 | WWW.MICROSOFT.COM/EN-AU

Microsoft Natural Ergonomic Keyboard 4000

A little long in the tooth (and name).

A unique keyboard to say the least, you will either love it or hate it. This is in part some of the reason the Microsoft Natural Ergonomic Keyboard 4000 has been on the market for so many years.

No doubt before today, you've come across someone using this lengthily-named unit, which we've been calling the 'Ergo 4000' for short. But have you tried using one before? If not, you're in for an interesting learning curve and potentially a little frustration as you adjust to a not just a different type of layout but a very different feel too.

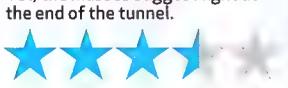
As the keyboard separates and isolates your left and right hand to the respective sides of the keyboard, a focus is created in allocating the key strokes as left-hand key strokes or right-hand key strokes. For many professional touch typists, this isn't too much of a concern. The single hand allocation can even evolve to become an operational grace, with long-term Ergo 4000 users claiming they are slower typists on traditional flat keyboards. However, if you're a self-taught touch typists, the Ergo 4000 has a knack for quickly reminding you of your touch typing imperfections.

For example, if you have a habit of crossing the touch typing divide, such as striking Y with your left hand, you will initially find the Ergo 4000 quite awkward to use, but the inkling of typing speed may encourage you to persevere.

If you love mechanical keyboards, look elsewhere. This unit uses dome-cap tech and lacks the forgiving touch of a mechanical switch.

Verdict

A potentially brutal transition. Yet, the masses suggest light at the end of the tunnel.



$120 | WWW.STEELSERIES.COM

SteelSeries Pro Gaming 6G v2

Gaming flair comes to work.

A stalwart brand in the competitive gaming scene and a product with a legion of fans, the SteelSeries Pro Gaming 6G v2 is a responsive, simple and no nonsense keyboard.

Featuring integrated stand-like forms on the underside towards the rear of the keyboard, the 6G v2 does away with the need for flip-out boosters to provide positive keyboard tilt via increased height at the rear of the unit. Instead, the integrated forms provide a solid, dependable and consistent feel to the keyboard with static positive tilt, ensuring no frills can potentially be damaged in transit.

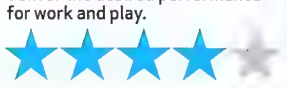
As mentioned, the 6G v2 has a history within the gaming scene and, yet, its simplified aesthetics could see it integrate seamlessly into an office work environment without any fanfare. Considering its smooth feel when typing, the unassuming visuals keep the practical nature of the unit focused – one can only hope to match it with equivalent focus in work duties.

The 6G v2 isn't much of a looker, but does it have to be in order to be considered as an office workhorse? When combining the enjoyable functionality with simplified design, topped by the sharp price point, the SteelSeries Pro Gaming 6G v2 makes a very strong argument for consideration in office use. You would certainly be well equipped to clutch a game of *CS:GO* during your lunch break.

That is, if the rest of the planets aligned to facilitate the lunchtime gaming fun!

Verdict

Sturdy and simple, yet ready to deliver the desired performance for work and play.



Professional mice in focus

Not one of the gaming rat pack?

Josh Collins tests five high-performance mice without the bling.

A computing mouse is just a mouse, right? Most certainly not! In today's technological world of niches, target demographics, market segmentations, usage scenarios and however else you wish to try to categorise, organise and arrange, things are no longer simple. The application of what was once a simple device that amused computer scientists with its similar form to that of a small rodent, has evolved considerably and, at times, without outwardly showing it.

The humble computer mouse has come a long way in many respects. Featuring an ever-growing number of buttons, adjustable features – both hardware and software based – and overall cumulative updates since the conception of a hand-held X-Y graph tracking human input device (HID), this unassuming device has changed considerably. Most modern mice have evolved to lose tails due to external factors too – Charles Darwin would be proud.

Then, in other respects, the timeless conceptual design of the computer mouse sees in many segments a close similarity to mice decades older. However, this simplistic view dismisses the many changes made 'under the hood'. These changes can vary, covering aspects such as tracking methodology – trackball, optical or laser – or perhaps the type of switches used for the click-input, right through to the connectivity approach, be it wired or a form of wireless.

In this roundup of desktop scurrying techno-beasts, we'll be looking at a range of computer mice that transverse a broad scope of prices, varying technical specification, design implementation and, to a degree, niche applications too.

MICE SPECIFICATIONS

PRODUCT	ADESSO IMOUSE E1	KENSINGTON MP230L	LOGITECH M570	LOGITECH MX ANYWHERE 2	LOGITECH MX MASTER
RELEASE YEAR:	2013	2015	2010	2015	2015
BINDABLE BUTTONS:	5	5	5	7	7
MOUSE WHEEL:	STEPPED	STEPPED	STEPPED	TOGGLEABLE STEPPED OR FREE SPINNING	TOGGLEABLE STEPPED OR FREE SPINNING
MAXIMUM DPI:	1600	3200	540	1600	1600
ADJUSTABLE DPI:	1000/1600	800/1200/1600/3200	NO	400-1600 IN 200DPI INCRIMENTS	400-1600 IN 200DPI INCRIMENTS
TRACKING METHOD:	OPTICAL SENSOR	LASER SENSOR WITH ON-GLASS TRACKING	OPTICAL TRACKBALL	DARKFIELD' LASER SENSOR WITH ON-GLASS TRACKING	DARKFIELD' LASER SENSOR WITH ON-GLASS TRACKING
CONNECTION:	WIRED	WIRELESS	WIRELESS	WIRELESS	WIRELESS
2.4GHZ WIRELESS:	NO	YES - VIA USB RECEIVER	YES - VIA USB RECEIVER	YES - VIA USB RECEIVER	YES - VIA USB RECEIVER
WIRELESS RECEIVER SIZE:	N/A	NANO	NANO	PICO	NANO
BLUETOOTH 4.0:	NO	NO	NO	YES	YES
BATTERY TYPE:	N/A	2 X AA	1 X AA	500MAH LITHIUM ION POLYMER (LI-PO)	500MAH LITHIUM ION POLYMER (LI-PO)
BATTERY LIFE:	N/A	N/A	18 MONTHS	UP TO 2 MONTHS ON SINGLE FULL CHARGE	UP TO 40 DAYS ON SINGLE FULL CHARGE
DIMENSIONS (HXWXD):	38 X 84 X 132MM	75 X 63 X 125MM	45 X 95 X 145MM	34 X 62 X 100MM	48 X 86 X 126MM
WEIGHT:	240G	113G	142G	106G	145G
WARRANTY:	3 YEAR LIMITED HARDWARED WARRANTY	1 YEAR LIMITED HARDWARE WARRANTY	3 YEAR LIMITED HARDWARE WARRANTY	1 YEAR LIMITED HARDWARE WARRANTY	1 YEAR LIMITED HARDWARE WARRANTY

$55 | ADESSO.COM

Adesso iMouse E1

The E1 gets tilted but not triggered.

If you haven't seen a vertically orientated mouse before, the Adesso iMouse E1 is going to catch your eye. Most likely, you'll be intrigued but venture back to the traditional mouse design for the simple fact that you're used to it.

Rethink that position, now. We had the same initial perception after years – decades even – of traditional mouse use and after using the Adesso iMouse E1 for a while, we're now past intrigued and floating towards converted.

That's not to say this mouse will replace Ol' Faithful straight away and you may be tempted to switch back purely out of habit and disliking change. Don't. Persevere and you may just enjoy it like we did.

Rolling in with a mid-tier price point to deliver a Baby Bear option to your Goldilocks needs, the price might be right for you to give this outsider a look-in.

For tracking, the unit features an optical sensor and, for the most part, it does all right. When on dedicated mousing surfaces, such as cloth, hard composite or silicon types, the Adesso iMouse E1 tracks as it should. However, get adventurous and you may find your pointer skipping across the screen.

The DPI scale isn't huge, but it gets the job done. While the DPI resolution may be low at 1,000 or 1,600, the choice is there with the tap of a DPI-centric button to toggle between the two as you wish.

Add to the mix the back and forward side-mounted buttons and it has the features we've all come to expect from a decently featured mid-tier mouse.

Verdict

Focused on ergonomics over performance, with a few tweaks, this could be a neat piece of kit.

★★★½☆

$39 | WWW.KENSINGTON.COM/AU

Kensington MP230L

Sleek looks and an attractive price.

The MP230L wants to take your hand for a ride. To assist, there are four built-in, preset DPI levels, set by pressing either the plus or minus DPI associated buttons atop the mouse behind the scroll wheel.

Each press of one of the DPI buttons will cycle up or down through the DPI range before either topping-out or bottoming-out. This range covers 800, 1,200, 1,600 and 3,200dpi options with each indicated by a unique LED colour shining through the centre of the scroll wheel, the light disappearing a moment later after setting. These colours are blue, green, yellow and purple across the range from bottom to top respectively.

The ambidextrous design leads itself to both left and right hand use, however, with the back and forward buttons on the left side – well placed for the right hand thumb. The button design feels a little awkward for lefties. We would've liked to see another two side buttons on the right of the mouse for true ambidextrous support.

It sports a 113g manufacturer-claimed weight (we weren't able to validate with scales); however, when loaded with two AA Ni-MH batteries for testing, the unit felt on par with the hefty 240g Adesso – a concern for a wireless pointer.

The MP230L delivers good tracking on glass surfaces, among other imperfect tracking surfaces. This paired with the approachable price point and wireless connectivity makes the MP230L an attractive option. While it may feel a little less premium than other offers when in-hand, its price is appropriately non-premium.

Verdict

It tracks well, has easily accessible and functional DPI settings and doesn't break the bank.

★★★★☆

$69 | WWW.LOGITECH.COM/EN-AU

Logitech M570 Trackball Mouse

Balls-out mousing prowess or balls-up fossil?

Trackballs – yes, they're still around. Some people are inseparable from them, while others may find the use intriguing, or even like a sideshow, before opting back to a traditional mouse.

However, if you're in the trackball fan category, the Logitech M570 delivers a very comfortable and easy-to-use unit. Featuring a well sculptured ergonomic fit, forward and back buttons protruding up from the sleek forward-falling curve left of the primary click buttons, and a fairly quick usage adaptation curve for those coming from a non-trackball using background, the M570 ticks most boxes of need.

The Logitech M570 ticks the boxes of need, but what about want? Well, the unit has wireless connectivity to allow for a clean, clear desk space and connecting via a nano wireless receiver. Sure, the feature may not be in huge demand given the mouse doesn't actually move around the desk area on a mouse pad like a traditional mouse, but it brings a certain clean aesthetic to its use and presence.

Tracking should carry on uninterrupted for many months, even years, with Logitech claiming a standard battery life of 18 months. Paired with a 3-year limited hardware warranty, the M570 has the long term in mind – both in terms of functionality and looking after your muscles via ergonomics afforded by trackball designs.

Though the scroll wheel was a little stiff at first, it freed-up with use.

In all, the M570 presented a well performing unit, albeit a little restrictive in its usage case – no casual gaming with this one!

Verdict

Those with worn out console-thumbs look elsewhere, but this is a very different mouse experience.

★★★½☆

apc RECOMMENDS

$68 | WWW.LOGITECH.COM/EN-AU

Logitech MX Anywhere 2

Here? There? ...Anywhere!

The Logitech MX Anywhere 2 is about portability, flexibility and ease of use, and its generally manageable size, shape and contours make it a pleasure to use.

There are times when small and portable can be too small and portable, to the detriment of general functionality, user ergonomics and user experience. Thankfully, thoughtful and smart contoured design help the Anywhere 2 to feel a little fuller in hand than most small travel mice and not flimsy – it's solid.

The desired performance and functionality are certainly present, though you do pay for the luxury of performance and proportion in the one mouse. The unit tracks effectively and efficiently on a variety of surfaces taking full advantage of the track-on-glass laser sensor. While testing on an assortment of surfaces, there were no negative tracking experiences.

With travel in mind, it's a good thing this unit rocks the longest battery life of the two MX mice tested, with up to two months usage stated by Logitech. Yet, the little tacker is still bested by the M570 trackball due to the M570's simplified design. Should the battery give out, a micro-USB cable can be connected to charge the device while in use.

With all this talk of travel, we can't overlook one gripe – what to do with the Pico wireless receiver when not installed in a USB slot on the go? With no in-mouse storage and even smaller than nano receivers, it is surely only a matter of time until the receiver goes MIA. Thank goodness for Bluetooth support!

Verdict

Anywhere, this mouse is ready and at your service. But be prepared for the price premium.

★★★★½

$109 | WWW.LOGITECH.COM/EN-AU

Logitech MX Master

A master craft for home and abroad.

One of the first things to come to mind when looking over the Logitech MX Master is the beautiful design. Be it the contours, the polygonal shape forming a textured lattice or the tasteful play between matte and gloss surface finishes paired with differing smooth and textured surfaces to the touch. It's a visually pleasing mouse to behold, and similarly thanks to considered ergonomics, it is equally pleasant to hold.

The gesture control is a nice touch. It could even help the most dedicated macOS lovers start to feel at home — or at least welcomed — using a Windows platform with gestures. But it's not just for Windows. No, the Logitech Options software, used to configure the advanced button-activated features, is compatible with both Apple OS X (10.8 or later) and Microsoft Windows (7/8/8.1/10).

With large yet effortlessly smooth bottom contact patches for the mouse to skate across surfaces, the MX Master made easy work of each surface we tracked the unit over. Paired with a 500mAh Lithium-polymer (Li-Po) battery centrally located, the mouse feels well weighted.

It has an unfortunate flaw due to the internally mounted battery lacking an external hatch access — there is nowhere to store the wireless nano receiver. In contrast, the predecessor, the Performance Mouse MX (M950), allowed for the nano receiver to be easily stored in the battery compartment, stowed for wherever you may be headed.

This minor gripe aside and with a myriad of other features, the MX Master is a fine mouse — albeit pricey!

Verdict

If you can swallow the hefty price and will make use of the features, it's a great mouse.

★★★★☆

Pro vs gaming: is there a difference?

What defines the difference between a gaming and professional orientated mouse?

In today's market, understanding the distinction to this question and the answer behind it is about as blurry as it can get. However, the simplified way of dissecting the scenario is to understand that the gaming mice are foremost performance-driven devices with a 'take no prisoners' approach — much like the competitive scene the units are typically developed for.

In the gaming mouse market, expect to see a focus on sensor response, switch button-click response, weight and even whether or not the cable has braided cloth shielding or traditional smooth plastic shielding. By contrast, professional market-orientated mice typically focus on areas such as ergonomics, battery life and use on-the-go with the need to have optical and laser sensors track on a myriad of surfaces rather than a specific surface type à la gaming mice.

As part of this feature, we have included a handful of gaming-oriented mice that, thanks to their more-sedate looks, can still comfortably sit within the professional mouse market segment.

Thanks to Mwave

mwave.com.au
Australia's Largest Online Tech Retailer

This roundup was made possible with the help of the team at Aussie tech-retailer Mwave (www.mwave.com.au).

Due to the combination of the Christmas/New Year holiday break period and the the resource- and staff-hogging international CES tradeshow in Las Vegas, many vendor representatives were either out of contact, unavailable, busy or otherwise unable to get product samples through for this feature. Mwave came to the rescue by supplying us with a number of products that we wouldn't have otherwise been able to include. Thanks a bunch guys!

Pro mice: an increasingly rare species

Why has the professional mouse market shrunk and gaming mouse market boomed?

Growing from a once niche market segment into a monster of immense proportions with significant market value and industry influence, the computer gaming sector has taken over many facets of focus within the computing world. Not surprisingly, the very device used to interact with the majority of computer games has got a thorough once-, twice-, thrice-over, looking for ways to improve, innovate and escalate the capability of what was once a simple device.

This swell of gaming-centric mice has not only diminished the professional-specific focused products within the market but also given them a solid run for their money — literally. Where there is demand, a market will grow. And this statement couldn't be truer for the computer gaming sector.

Reports from numerous sources ranging from research firms to game publishers and distribution networks, have all concluded — for a number of years now — that the year-on-year growth of the computer gaming sector (not just PC gaming, but inclusive of mobile, social media and so on) is immense and seemingly not slowing down any time soon, with gaming on a PC-type device at the forefront!

Looking at one of the industry's broadest-reaching reports by SuperData, the video game market's total digital revenue increased year-on-year in November 2016 to $6.7 billion. In this same period Premium PC gaming (such as *Battlefield 1* and *The Witcher 3*) saw 18% market growth year-on-year, slipping just behind mobile gaming growth, which hit 19% and has been the historic leader of recent years. This step behind mobile gaming is a minor slip for PC gaming after beating mobile gaming market value by a healthy $10 billion in a strong 2015 showing, scoring $35 billion versus $25 billion.

It's not just about market value either; it's the substantial swarm of players, too. The top four PC games by player count per month account for 185 million unique players across the titles. While there would be some overlap of the player base within that figure (i.e. a player owns and plays both *League of Legends* and *Overwatch* but is a unique player of each), PC gaming is nonetheless a hugely powerful force to be reckoned with, a market to be explored and, from the vendor perspective, milked.

To illuminate the matter a bit more clearly, these are the top-four online PC games by player count:

- *League of Legends* — 100 million players per month
- *Hearthstone* — 50 million players per month
- *Overwatch* — 20 million players per month
- *DOTA 2* — 15 million players per month

Seeing the figures, it's easier to understand why seemingly every tech company is introducing gaming peripheral products to its lineup. From memory vendors to display vendors, it appears everyone wants a piece of the gaming peripheral market and the humble mouse is no longer so humble anymore, taking centre stage along with the spotlight.

The continued market growth in terms of both player base (market density) and value has been a huge driving force behind innovation and development of gaming mice specific to the needs of not just gamers in general, but gamers across the three core sub-genres; first person shooter (FPS), massively multiplayer online role-playing games (MMORPGs) and massive online battle arenas (MOBAs).

This has introduced significant choice to the broader computer mouse market and for this the consumer and end-user has gained opportunity and selection for their unique needs and wants. While it may be frustrating seeing "gaming" plastered on everything, the next time it annoys you, just read it as "developed and focused". At the end of the day, a button still goes click and a pointer still gets moved on screen. ■

Backup basics covered: the best two-bay NAS boxes

Need a personal NAS to back up your work? Nathan Taylor tests six.

So your PC's storage just doesn't cut it anymore for all the media you've downloaded. Those fancy new SSDs do have a downside after all. So maybe you're looking to up your capacity with a network-attached storage device – a device that can offer not just additional terabytes but actually provide extra services, like DLNA streaming to your smart TV, automated backup to and from PCs and cloud services, remote access to files, shared file access, live file transcoding for mobiles and maybe even more.

Below, we've looked at six of the top two-bay NAS boxes available today, perfect for someone who's willing to pay a little more to get a device that does a lot more. They're all fast, and some offer a vast host of additional features, like direct output to a TV screen, business and content services and much more.

HOW WE TESTED

For each device reviewed here, we performed a simple copy test and measured both the write and the read speed, in megabytes per second. All tests – bar the Seagate – were performed with twin Hitachi 4TB drives installed and set up in RAID 1. For the Seagate, we used the included drives.

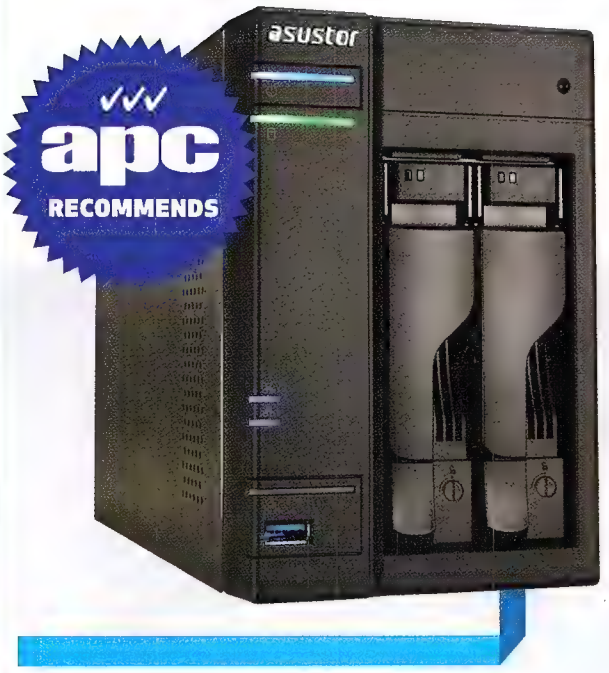
For NASs that supported link aggregation (that's using two Ethernet ports and load balancing across them), we did use both Ethernet ports. However, given the client device only has a single port, this is not really reflected in the results. Link aggregation in general doesn't make a single client go faster – it makes multiple clients access the NAS faster. As it is, pretty much all of these NASs (except perhaps the Seagate) effectively max out a single Gigabit Ethernet connection.

"Maybe you're looking to up your capacity with a network-attached storage device — a device that can offer not just additional terabytes but actually provide extra services."

NAS SPECIFICATIONS AND TEST RESULTS

PRODUCT	ASUSTOR AS6202T	NETGEAR READYNAS 212	QNAP TS-251A	SEAGATE PERSONAL CLOUD 2-BAY (8TB)	SYNOLOGY DISKSTATION DS716+II	WD MY CLOUD PRO SERIES PR2100
VENDOR	ASUSTOR	NETGEAR	QNAP	SEAGATE	SYNOLOGY	WESTERN DIGITAL
WEBSITE	WW.ASUSTOR.COM	WWW.NETGEAR.COM.AU	WWW.QNAP.COM	WWW.SEAGATE.COM	SYNOLOGY.COM	WWW.WD.COM
STREET PRICE	$685	$420	$450	$500*	$600	$590
BAYS	2	2	2	2	2	2
PROCESSOR	INTEL CELERON N3160 QUAD-CORE 1.6GHZ	QUAD-CORE ARM (CORTEX A15), 1.4GHZ	INTEL CELERON N3060 DUAL-CORE 1.6GHZ	UNSPECIFIED ARM	INTEL CELERON N3160 QUAD-CORE 1.6GHZ	INTEL PENTIUM N3710 QUAD-CORE 1.6GHZ
MEMORY	4GB (EXPANDABLE TO 8GB)	2GB	4GB (EXPANDABLE TO 8GB)	UNSPECIFIED	2GB	4GB
NETWORKING	TWO GIGABIT PORTS WITH LINK AGGREGATION	TWO GIGABIT PORTS WITH LINK AGGREGATION	TWO GIGABIT PORTS WITH LINK AGGREGATION	ONE GIGABIT PORT	TWO GIGABIT PORTS WITH LINK AGGREGATION	TWO GIGABIT PORTS WITH LINK AGGREGATION
USB AND OTHER PORTS	THREE USB 3.0 HOST PORTS,TWO USB 2.0 HOST PORTS, TWO ESATA PORTS, IR RECEIVER	THREE USB 3.0 HOST PORTS, ONE ESATA PORT	THREE USB 3.0 HOST PORTS, IR RECEIVER, SD CARD READER	ONE USB PORT	THREE USB 3.0 HOST PORTS, ONE ESATA PORT	TWO USB 3.0 HOST PORTS
LOCAL HDMI OUT	YES (1.4B)	NO	YES	NO	NO	NO
OPERATING SYSTEM	ASUSTOR DISK MANAGER (ADM)	READYNAS OS	QTS	SEAGATE NAS OS	SYNOLOGY DISKSTATION MANAGER	MY CLOUD OS
OTHER LICENSES	FOUR CAMERA LICENSES FOR SURVEILLANCE CENTER	-	TWO CAMERA LICENSES FOR SURVEILLANCE STATION	-	TWO CAMERA LICENSES FOR SURVEILLANCE STATION	-
TEST RESULTS (MB/S)						
READ	104.3	96.3	101.4	79.2	106.2	88.5
WRITE	98.8	88.6	86.5	40.3	103.2	75.1

*NOTE THAT THE SEAGATE DEVICE COME WITH DRIVES (UNLIKE THE OTHERS, WHICH HAVE DISKLESS PRICES LISTED)



$685 (DISKLESS) | WWW.ASUSTOR.COM

Asustor AS6202T

Pricey but powerful.

With a processor that's about as fast as you'll find, up to 8GB of memory and more ports than you'll ever need, this is a device that offers both performance and features. Of course, you'd expect that, given it's also the most expensive in our roundup.

Part of that cost comes down to the fact that this functions as a full-on PC, including an HDMI port for connection to a TV and a copy of Kodi for media playback. Like QNAP's solution, this obviates the need for an intermediate network media player. It even includes an infrared port for receiving remote control signals (a remote is not included), or you can use the Kodi remote app on your mobile. It does not, however, support any streaming services like Netflix or Stan.

Asustor's firmware is built on the same Linux foundation as QNAP and Synology, and includes a full windowing interface – accessible through a web browser or directly on a screen attached to its HDMI port – and a large host of third-party apps. It includes a Surveillance Center for capturing and managing IP camera streams and pretty much every server app you could possibly ever need – even virtualisation, which means you could run, say, Windows 10 on it inside a virtual machine.

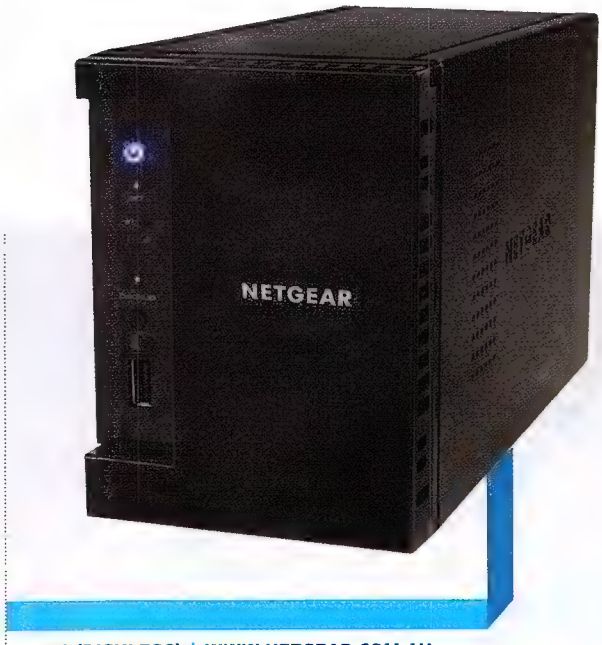
Installing drives is easy and they can be hot swapped in RAID 1 mode. There are handy mobile apps for remote access, syncing and media playback are available as well.

Its capacity to function as a low-end PC or media player gives in an edge over much of the competition – an edge it rather needs, given the price.

Verdict

The price is high, but it is more capable than any other NAS tested here.

★★★★☆



$438 (DISKLESS) | WWW.NETGEAR.COM.AU

Netgear ReadyNAS 212

Prides itself on its accessibility.

The ReadyNAS 212 has a simple tabbed interface, a limited array of third-party apps and services, and excellent mobile and desktop apps for accessing the most common features of the NAS. If you want fancy services like web publishing, telephony or surveillance, then this is not the platform for you. However, if you just want a capable file/media server that's easy to set up and has great mobile and desktop apps for management, backup and syncing, this is an absolutely solid choice.

Unlike most of the high-end competition (which use x86 processors), the ReadyNAS runs on an ARM processor, which we worried might not have the juice to perform real-time transcoding – worries that proved unfounded when we easily transcoded a 1080p video in real time. Indeed, it's media service was nearly flawless – fast and smooth at all resolutions. Its copy performance was also good, close to par with the x86 performance on RAID 1, and it has three USB 3.0 ports as well as an eSATA port for additional backup.

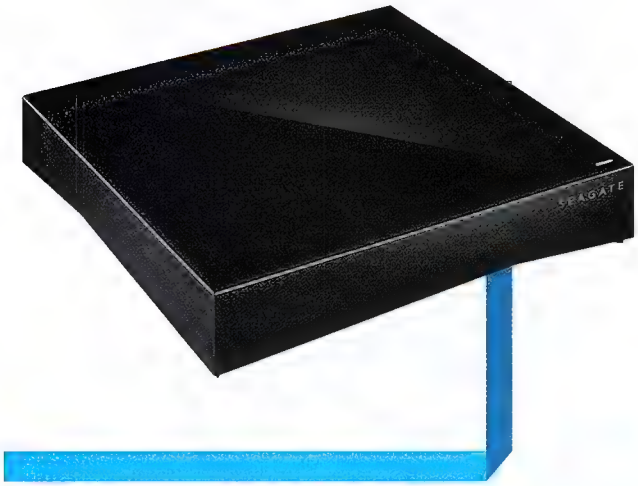
If you want something that's fast and easy, and that's managed by a straightforward app rather than a full-desktop windowing interface, the ReadyNAS is actually a very good choice.

The inclusion of a free virus scanner is great (though you have to know it's there, as it's switched off by default), the screwless drive installation is smooth and simple and the apps do a good job of handling the things you most commonly want to use a NAS for: media service, file storage and remote access.

Verdict

A bit limited in its functionality, but it keeps things simple with app-based control and access.

★★★½☆



$490 (8TB) | WWW.SEAGATE.COM/AU/EN

Seagate Personal Cloud 2-Bay (8TB)

For those with simple needs.

One of the older products in our review, the Seagate has a place for people looking for more value from their NAS. At around $500 with two 4TB drives pre-installed, the Seagate is less expensive than several of the diskless NASs here.

It's also a nice looking device, with a sealed black case arranged horizontally, suitable for placement anywhere in the home, including the loungeroom.

Of course, the lower price entails a lot of compromises. Seagate doesn't specify the processor or memory, but its performance figures suggest something considerably less powerful than the other devices here.

There's only a single USB port and single Ethernet port for connectivity. It uses Seagate's NAS OS, which is in line with Netgear and WD's offerings, a simple and elegant tabbed interface that doesn't offer a huge amount in the way of services and third-party add-ons, but instead offers straightforward solutions for people looking primarily for file and media services as well as backup and sync. It does have a few key apps you can install – including a surveillance manager, Plex, free antivirus, BitTorrent Sync and WordPress.

The mobile and desktop apps for access to the NAS are very well made, perfect for people who just want a 'plug it in, install an app and go' NAS. And that's the kind of device this is; it's not made for power users looking for fine control and extensive services and apps – it's for people who just need the core NAS services in a nice, affordable box with easy-to-use mobile and desktop apps to get them going.

Verdict

It's not particularly powerful or fast, but it's a nice, simple and affordable solution.

★★★½☆

apc HOT PRODUCT

$450 (DISKLESS) | WWW.QNAP.COM/EN-AU

QNAP TS-251A

Flaws aside, it's everything we'd want.

QNAP's TS-251A is everything we want in a two-bay NAS. It's incredibly versatile and has so many little features and touches that set it apart from the competition.

Its hardware is not as powerful as Asustor or Synology offerings, but it's also a lot more affordable.

QNAP has arguably the most capable firmware on the market today. Like Synology and Asustor's solutions, it's built on Linux and has a full windowing interface and a large host of third-party apps available, but it's the first party elements that make it so strong. QNAPs 'stations' include tools for media service, monitoring and capturing streams from IP cameras, web-based video and photo galleries, VPN services, virtualisation, karaoke, backup and sync and more. Its weak point is probably the mobile and desktop syncing apps provided by QNAP: they're capable, but their UI is a mess and they can be confusing to set up. But QNAP keeps things relatively simple, with on-off switches for features.

The firmware is coupled with hardware with a lot of great elements. It has an actual HDMI port, so you can connect the QNAP directly to a screen and play media on it. It doesn't support streaming services, but it you can run Kodi or Plex on it and it does come with an IR receiver and remote control for controlling those apps from your couch.

There's also the handy SD card reader and USB QuickAccess port, a device port that lets you directly connect a PC to it like you might an external hard drive.

Verdict

Awesome. Powerful, versatile, easy to use, and even supports direct connection a TV.

★★★★★

apc RECOMMENDS

$600 (DISKLESS) | WWW.SYNOLOGY.COM

Synology DiskStation DS716+II

Caught in the middle.

Synology's premier two-bay device, the DiskStation DS716+II is a powerful and very fast NAS, capable of providing much more than just media and file services.

Synology's firmware provides a full GUI through its web interface, with movable windows, icons, and status and notification bars. It also has the ability to install a huge host of first-party and third-party apps and services onto the NAS.

Pretty much any server application you can think of is available, including syncing apps, cloud backup, IP telephony, virtualisation, content management and web publishing, backup, streaming servers, email services, web caching, VPN and security services, wikis, customer relationship management and antivirus.

Of particular note are a simple cloud-based office solution for editing stored documents in a web browser (like a trimmed down Google Docs) as well as arguably the best IP camera surveillance manager available with a NAS.

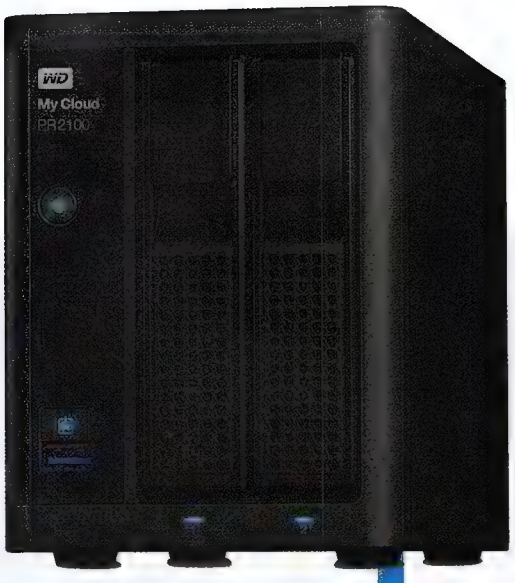
It delivered the fastest read/write performance of any tested NAS, and the hardware looks great and supports easy disk swapping, as well as passive CPU cooling.

However, there are some disappointments. The inclusion of only 2GB of memory can limit its usefulness. It also sits in the nowhere land between the all-out Asustor and more affordable QNAP, and we would find ourselves generally leaning one way or the other. But still, this is an excellent NAS overall, with one of the industry's best firmware solutions and powerful underlying hardware.

Verdict

Great firmware, powerful hardware and fast, but rather expensive given it only has 2GB of memory.

★★★★☆



$599 (DISKLESS) | WWW.WD.COM

WD My Cloud Pro Series PR2100

Impressive internals, but limited.

One of the newest entries in the WD My Cloud series, the PR2100 boasts some impressive hardware, on par with the Asustor and Synology NASs. But it fails to do enough with that hardware, with a limited suite of services and tools.

Now there's nothing wrong with having a simple tabbed interface. For people who mostly just want the basics of file and media services, that's perfectly fine, especially if coupled with solid mobile and desktop apps. But if you're going to crank up the hardware and the price as WD have done here, you also need to include more stuff to do with that hardware. But WD's lineup of services – first- and third-party – is rather anaemic. It still provides the same services as the cheaper devices in WD's lineup, and the more powerful hardware seems a little pointless.

On the upside, WDs mobile and desktop support apps are among the best in class, especially for backup. It does provide antivirus, and the inclusion of a server target for Acronis True Home makes this a premium choice for people looking primarily for backup. It's also very easy to administer the NAS, with WDs Cloud OS among the most straightforward and well explained NAS operating systems around.

Installing new drives is totally toolless (you just slide them in and out, which is nice), and you can seamlessly add extra USB drives by plugging them into one of the USB 3.0 ports. There's an extra power port for redundancy and a second Ethernet port for failover and load balancing as well.

Verdict

The server app selection is too limited for the impressive hardware, but it's very easy to use.

★★★☆☆

TAKE FULL CONTROL OF YOUR WINDOWS APPS

TAKE CONTROL OF YOUR APPS AND YOU TAKE CONTROL OF YOUR PC. ALEX COX EXPLAINS EVERYTHING YOU NEED TO KNOW ABOUT MANAGING YOUR INSTALLED CONTENT.

Applications – programs you run on your PC – are a constant. They're always there. We all use them, and our machines would be dusty husks without them. But they do have a tendency to get a bit out of control, particularly if a system has existed for a long time.

An application almost always consists of a bunch of files; the more apps and games you have installed, the more files exist on your hard drive. This isn't, in itself, a problem, until your drive is filled with ten thousand chunks of goodness-knows-what, and a single search operation takes half an hour because Windows has decided it must meticulously inspect every single thing.

Here's a quiz for you: What was the last program you installed, and where is it on your hard drive? We'd wager that, in the first count, you're probably not sure, and in the second, you hammered through the process, let it ensconce itself in goodness-knows-what folder, and have absolutely no idea what other things it scattered over your hard disk.

Going with the flow of program installation is normal and entirely understandable, but it's not difficult or onerous to get yourself organised, and a well-sorted PC will stand you in good stead for continued use. Unless you use extreme methods, you won't ever be able to stop the miasma of random files seeping through your PC. But we'll show you how to seek them out, and how to remove unwanted programs entirely. We'll even show you new ways of installing software that make it easier to manage, update, and uninstall when you're ready. And if the thought of installing software is giving you some form of filesystem OCD, we can teach you how to make your own portable apps that don't need installing in the first place, or how to integrate your favorite apps into a custom build of Windows 10 that starts a clean PC exactly the way you want it.

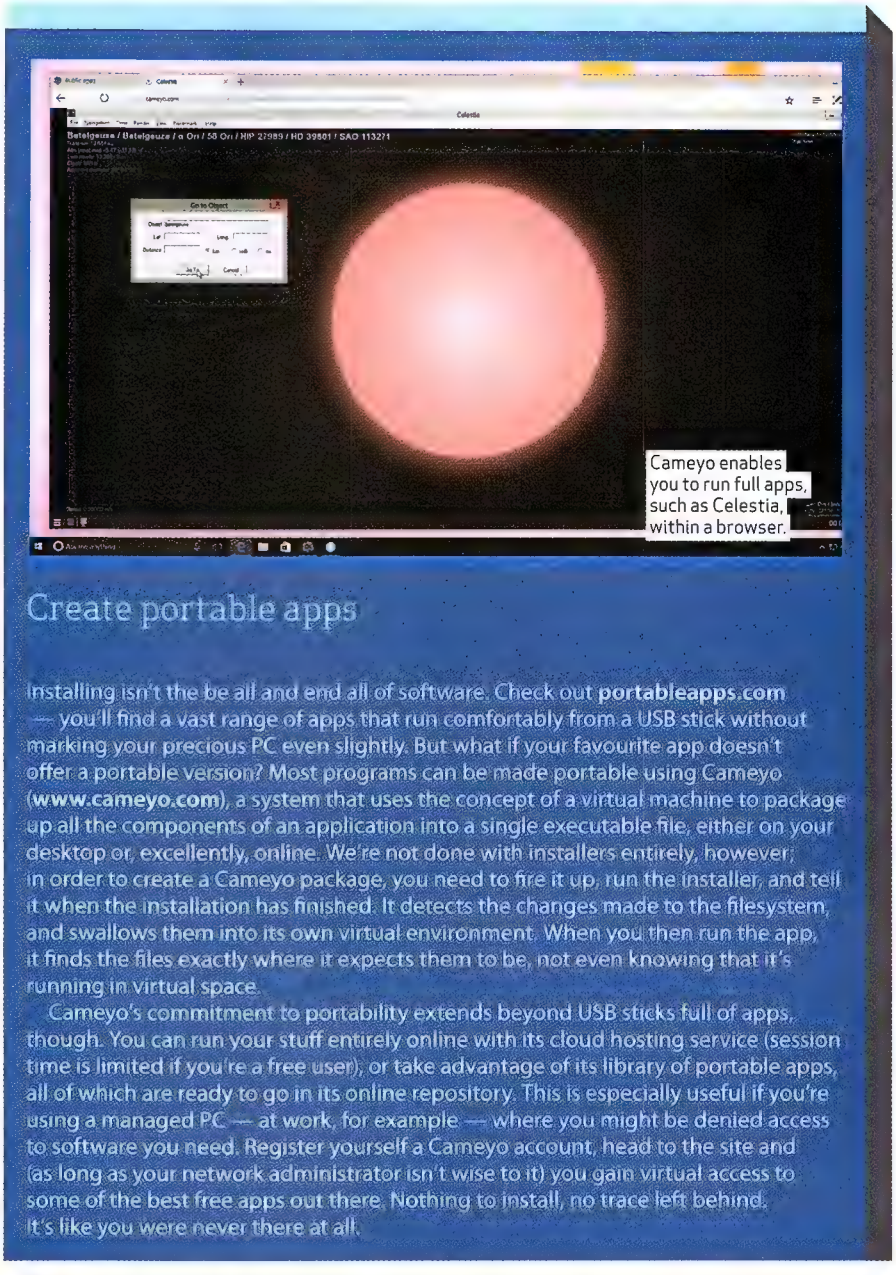
WHAT IS INSTALLING?

Once upon a time – and we're going back some 20 years here – getting a program up and running involved little more than placing a few files in a folder on your PC. That's all an installer did. Don't have the right drivers? Tough luck. Find them yourself. Operating system not up to scratch? Go through all the hassle first, and you'll find out that something's wrong when you try to run your application. A dark time, but one with benefits: Removing a program folder meant, usually, erasing all trace of that software. A simple scheme from a time when, however bleak things might have been, operating systems were less complex and software depended on little.

Try manually excising a bit of software now, and you'll not have a good time; the typical modern installer is responsible for more tasks, and spreads the software much wider, and uninstallers are required to scrape off the remains of redundant apps. The installer decompresses large files, which have been archived to ensure an efficient distribution size. It determines whether you're installing from scratch or upgrading. It places references to program variables in the Windows registry, and configures other files to suit your hardware and personal preferences. It downloads, or upgrades, software dependencies – drivers and software frameworks that the program being installed may depend upon to run. And it does even more besides.

To make things even more complex, there's not one kind of installation package, though this won't make a huge difference to the average user. You most regularly come across executables (EXE files), which tend to use some kind of third-party program to get the job done, or Microsoft Installer (MSI) files, which do the same thing using Windows' built-in installation components. Others – the likes of CUB, MSP and MSM – also use the Windows Installer and are meant for patching or modifying components. You don't see them often while using Windows on the desktop, if at all, although those who stray into server territory might get more familiar.

For all we've said, a complex installation method isn't strictly required for every app. Many apps have been designed to run in a so-called "portable" configuration, where their content is contained in a single folder and requires no installation whatsoever. While these are few and far between – portable apps are usually small tools, although programs such as LibreOffice are also available in a non-installed format – they're perfect if you want to carry around a toolkit of apps on a USB stick. And you

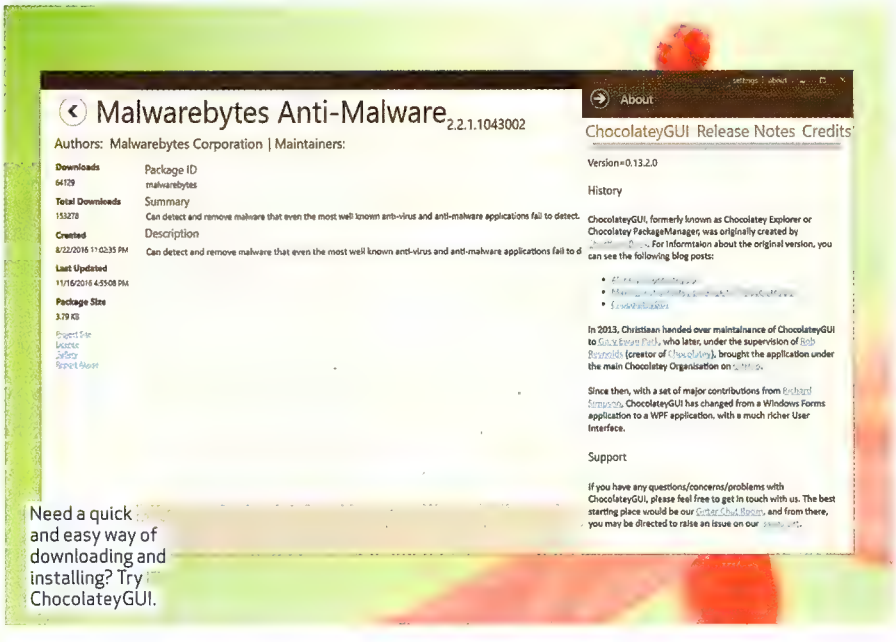


Cameyo enables you to run full apps, such as Celestia, within a browser.

Create portable apps

Installing isn't the be all and end all of software. Check out **portableapps.com** – you'll find a vast range of apps that run comfortably from a USB stick without marking your precious PC even slightly. But what if your favourite app doesn't offer a portable version? Most programs can be made portable using Cameyo (**www.cameyo.com**), a system that uses the concept of a virtual machine to package up all the components of an application into a single executable file, either on your desktop or, excellently, online. We're not done with installers entirely, however; in order to create a Cameyo package, you need to fire it up, run the installer, and tell it when the installation has finished. It detects the changes made to the filesystem, and swallows them into its own virtual environment. When you then run the app, it finds the files exactly where it expects them to be, not even knowing that it's running in virtual space.

Cameyo's commitment to portability extends beyond USB sticks full of apps, though. You can run your stuff entirely online with its cloud hosting service (session time is limited if you're a free user), or take advantage of its library of portable apps, all of which are ready to go in its online repository. This is especially useful if you're using a managed PC – at work, for example – where you might be denied access to software you need. Register yourself a Cameyo account, head to the site and (as long as your network administrator isn't wise to it) you gain virtual access to some of the best free apps out there. Nothing to install, no trace left behind. It's like you were never there at all.



Need a quick and easy way of downloading and installing? Try ChocolateyGUI.

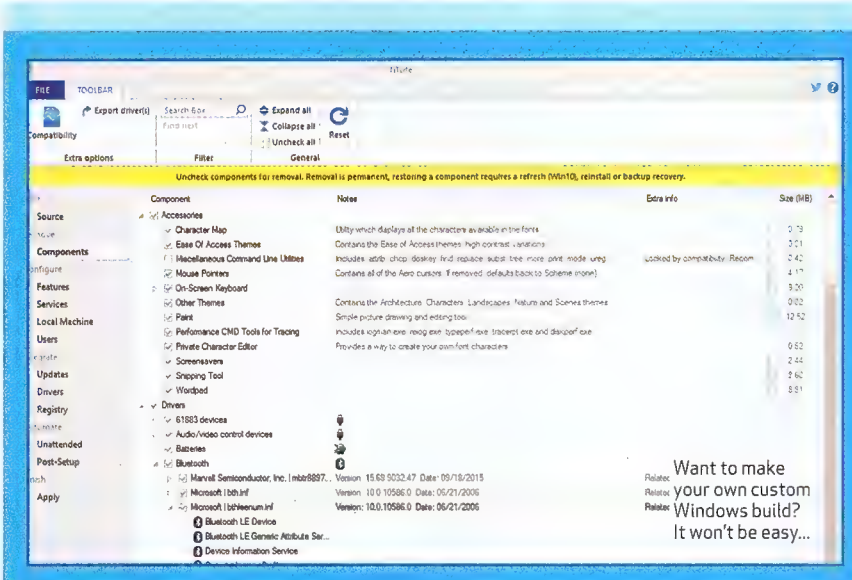
can even make your own, in a roundabout way; see Create Portable Apps (back over the page).

We have no doubt that you've installed programs before. Taking you through the ins and outs of clicking 'Next' a few times in the course of a traditional software installation would be insulting your intelligence. But as you may have guessed by the extent of this feature, the standard way is not the only way of going about things. The regular way, perhaps, but not the best in all cases.

You may, for example, have grabbed some of the rare decent software from the Windows Store, Microsoft's poorly-policed den of application iniquity. Whatever your feelings on its content, it has a number of advantages –

```
icrosoft Corporation. All rights reserved.

\system32>choco install notepadplusplus -y
 v0.10.3
Removing incomplete install for 'notepadplusplus.install'
 the following packages:
splus
ing you accept licenses for the packages.

splus.install v7.2 [Approved]
splus.install package files install completed. Performing other installation steps.
rs to be downloaded already. Verifying with package checksum to determine if it needs to be redownloaded.
ch.
ch.
 notepadplusplus.
splus has been installed.
splus installed to 'C:\Program Files\Notepad++'
ll of notepadplusplus.install was successful.
 installed as 'EXE', install location is likely default.

splus v7.2 [Approved]
splus package files install completed. Performing other installation steps.
ll of notepadplusplus was successful.
 install location not explicitly set, could be in package or
install location if installer.

 installed 2/2 packages. 0 packages failed.
og for details (C:\ProgramData\chocolatey\logs\chocolatey.log).

\system32>
```

Chocolatey's command-line goodness tastes great.



Want to make your own custom Windows build? It won't be easy...

Custom Windows install

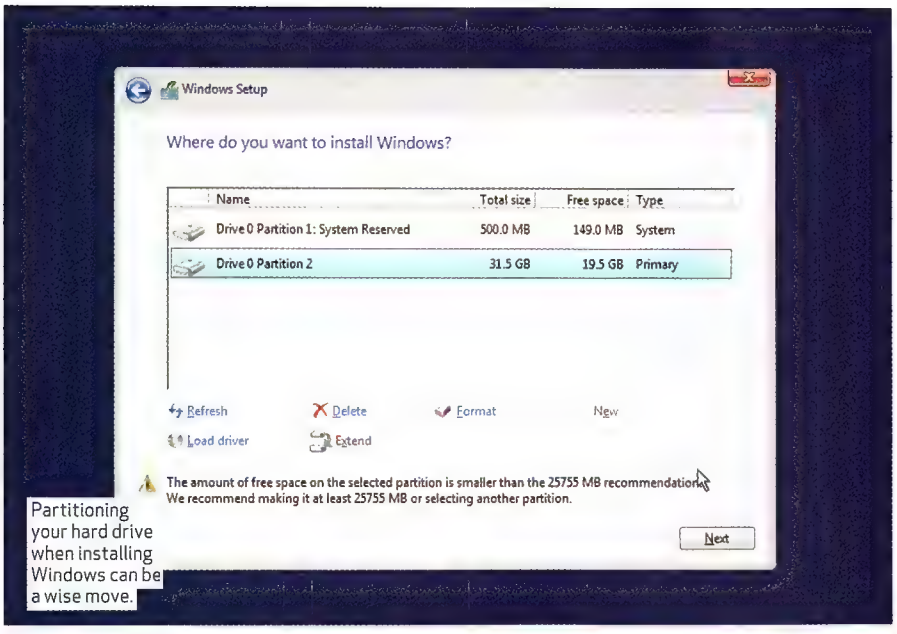
Windows Store apps run in a sandboxed mode, isolated from the main OS, which means that even if something malicious slips through, it can't attack your PC directly, and installing, removing and updating Store apps is quick and easy.

The technically-minded might avoid it, and there are other ways of sandboxing apps you might not know of (see 'Sandboxing applications' on page 71), but don't underestimate its convenience. So that's one alternative, but let's explore some of the other ways of getting software on your PC.

BATCH MANAGEMENT

Sometimes, you're starting entirely from scratch with a clean Windows installation that you need to get up to speed in a hurry. Problem is, deploying a new machine can be a massive slog of a job. Collecting together the items you need is one thing, but running through the individual installation processes of all that software is time-consuming and labour-intensive, particularly if you're dealing with programs that include sneaky shovelware in their installers. One wrong click and you're infested, meaning it's not even a job you can do on autopilot. But there's a tried and tested solution that has been dealing with all that nastiness for a number of years, and it's even applicable if you're not installing a machine from scratch.

Ninite (**www.ninite.com**) compresses all that work into a single job, then deals with all the effort for you. It installs everything you need, preselected to your specifications, as long as it's in the extensive list of supported software, without any hassle. Head over to the site, check a few boxes for your desired apps, and click the big button to download the installer. Run it, and Ninite automatically gets hold of the latest versions of your chosen free programs



Partitioning your hard drive when installing Windows can be a wise move.

Uninstalling is easy — and comprehensive — with IOBit's tool.

— which range from security and development tools to messaging and creative apps — and installs them in the background. They all end up in their default locations, and Ninite also ensures that those clandestine crapware boxes are never clicked. While you can't use it for automatic uninstallation unless you opt for the pro version (US$20 a month, which also gets you the ability to perform network installs), it does support upgrading; an occasional run is all it takes to keep all of the applications on your system up to date.

PACKAGE MANAGEMENT

Although this feature is dealing with Windows, it would be a canny move to take a look at what the competition is up to. Most flavors of Linux are perfectly capable of installing software from files that have been directly downloaded — however, that's not the usual method. Linux tends to rely on a disparate group of package managers, small tools that can download, install, update and remove software — thus dealing with both the hassle of finding it and installing anything else your machine might require to get it running.

Windows has been employing its own under-the-hood package manager for some time, a Powershell app called PackageManagement, which is a fork of open-source downloader OneGet. It is bafflingly complex — mastering it is a task for another day, although if you're intrigued enough to experiment, you can read more about it at **bit.ly/2gstsvW**. Better, we think, to start with something more user-friendly and sweet.

Chocolatey is the delicious-sounding Windows analog to Linux tools such as 'apt-get', 'yum' and 'pacman', and it works in much the same way. Microsoft even uses its framework (which spawned from open-source app NuGet, just to add to the complexity of the software management family tree) as part of PackageManagement, which is a ringing endorsement. To get the command-line version installed, open up an administrative command prompt by holding Shift, right-clicking the Start button, and selecting 'Command Prompt (admin)'. Head over to **www.chocolatey.org/install**, then copy and paste the top install line into your command prompt. Let it run for a while, then close and reopen the window once the C:> prompt reappears.

The first thing to try is, we have to admit, a little recursive. Try typing: `choco upgrade chocolatey` into a fresh command prompt, and you'll see Chocolatey's interface in action as it heads off to see whether there's a new version of itself available. There won't be, of course, because we've just installed it. But if there were, it would download and perform the upgrade autonomously. Let's get hold of something a little more useful now:

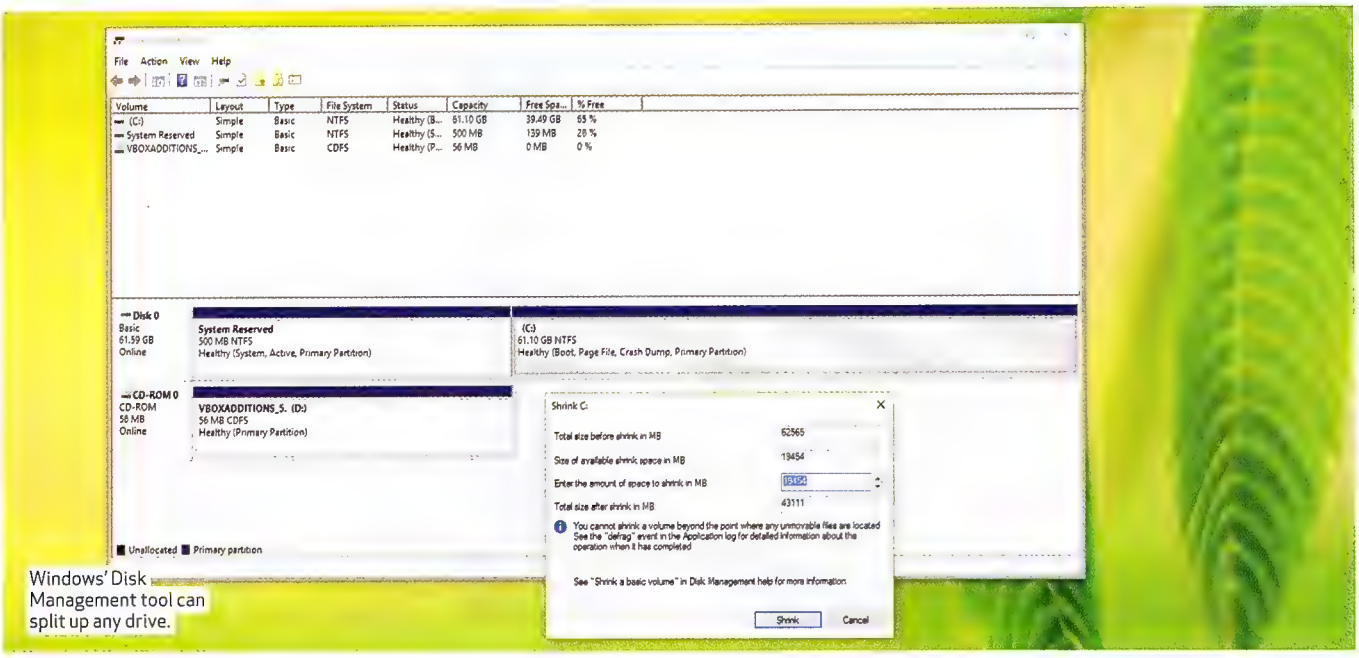
```
choco install
notepadplusplus -y
```

This grabs excellent text editor Notepad++ from the internet and safely ensconces it on your system, forgoing any standard Windows installer. The `-y` part on the end of that command means you tacitly accept any confirmations that might come up during the install, so it happens in an automated manner. Replace `install` with `upgrade` or `uninstall` to perform those tasks, and check out the Chocolatey docs at **www.chocolatey.org** to find out more — there's a huge number of ways to use it via the command line.

You may be more comfortable with a graphical version, however; use Chocolatey to install the package chocolateygui and, once it's complete, you'll find it in your Start menu as usual. It's an easy interface through which you can manage the packages that you've installed on your system, and clicking the Chocolatey tab on the left leads you to the other applications you could have Chocolatey manage for you. The next time you need a piece of software, head to Chocolatey, type the name of the app in its search bar, and we'd wager it'll be there.

SPACE MANAGEMENT

We're spoiled by today's enormous spinning drives and ever-growing SSDs. Space doesn't tend to be an issue. But managing it really should be, both in terms of what's there and where you're putting it. Yes, Windows search


File Action View Help
Volume Layout Type File System Status Capacity Free Spa... % Free
(C:) Simple Basic NTFS Healthy (B... 61.10 GB 39.49 GB 65 %
System Reserved Simple Basic NTFS Healthy (S... 500 MB 139 MB 28 %
VBOXADDITIONS_... Simple Basic CDFS Healthy (P... 56 MB 0 MB 0 %
Disk 0
Basic
61.59 GB
Online
System Reserved
500 MB NTFS
Healthy (System, Active, Primary Partition)
(C:)
61.10 GB NTFS
Healthy (Boot, Page File, Crash Dump, Primary Partition)
CD-ROM 0
CD-ROM
56 MB
Online
VBOXADDITIONS_5. (D:)
56 MB CDFS
Healthy (Primary Partition)
Unallocated Primary partition
Shrink C:
Total size before shrink in MB 62565
Size of available shrink space in MB 19454
Enter the amount of space to shrink in MB 19454
Total size after shrink in MB 43111
You cannot shrink a volume beyond the point where any unmovable files are located. See the "defrag" event in the Application log for detailed information about the operation when it has completed.
See "Shrink a basic volume" in Disk Management help for more information.
Shrink
Cancel
Windows' Disk Management tool can split up any drive.

can dig things up quite readily, but despite Microsoft's attempts to improve it, searching on NTFS drives is simply not a quick task. However, if your files are well, uh... filed, you may never need to do a Windows search again.

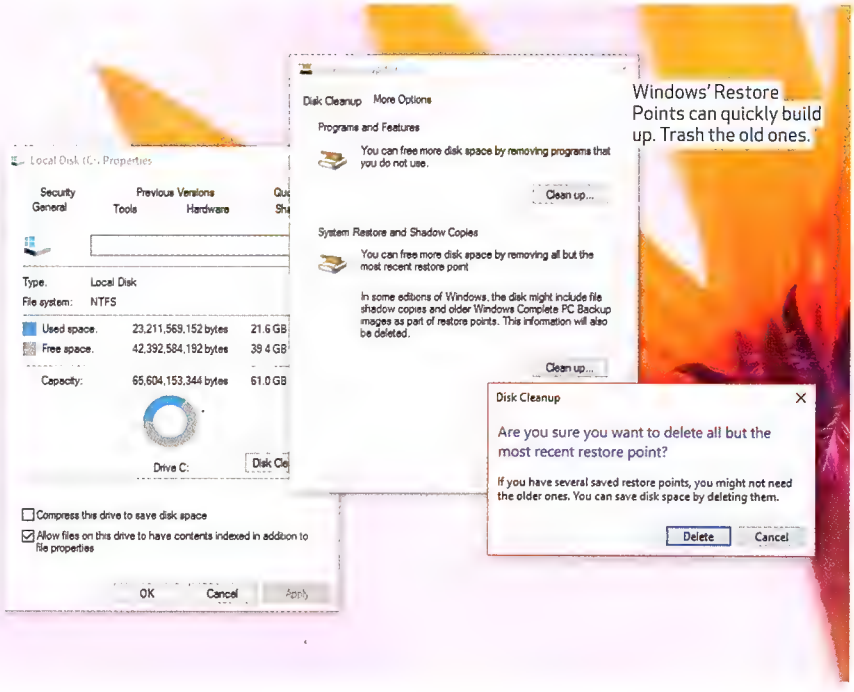
Consider, before you do anything rash, changing your default installation directory. By default, most applications you install either nestle in the Program Files or Program Files (x86) folders, splitting them up between those that run natively in 64-bit (the former) and those that don't. Logically, this makes sense; practically, 64-bit Windows is now the mainstream, 32-bit applications are entirely compatible with 64-bit systems, and there's no reason to split them apart in this way. It's just confusing. But during each program installation (bar those of poorly-coded programs that rely on specific directories to run), you are given a choice as to where you install your software. Setting up your own folder structure – say, a Programs folder, with folders within labeled Music, Office and so on – is a great way both to neaten up your collection and find out what you have installed when the Start menu begins to get a bit unruly. It's a five-minute manual job that will make life easier in the future.

Desktop Windows isn't nice enough to offer folder quotas for files in the same way its server-focused skew does. Quotas, as you might expect, help control the amount that users are allowed to store. Restricting yourself in this manner is a great way to make sure you're cleaning out the dead wood regularly – if you're forced to make room every time you want to stick a new game or program on your system, those tough decisions suddenly get much easier to make. As we've said, Windows doesn't naturally support such storage handcuffs, but we can get around it with a little cunning and a lot of partitioning.

> "Drive space doesn't tend to be an issue. But managing it really should be."

CHOPPING AND CHANGING

By splitting your drive up into several chunks, you can effectively organise your content and stifle the amount of it that you allow yourself to hang on to. Why not give yourself a virtual D: drive for your programs, an E: drive for photos, a Q: drive for videos, and so on? There are secondary benefits: You can quickly defragment your OS partition without worrying about the rest of your drives; certain malware only affects a single partition, leaving the rest of your data safe; and formatting your Windows partition to fully reinstall doesn't mean a loss of your files. That said, as we've expounded upon, your installed programs are unlikely to work properly, thanks to the required references that get scattered through Windows whether


Disk Cleanup More Options
Programs and Features
You can free more disk space by removing programs that you do not use.
Clean up...
System Restore and Shadow Copies
You can free more disk space by removing all but the most recent restore point
In some editions of Windows, the disk might include file shadow copies and older Windows Complete PC Backup images as part of restore points. This information will also be deleted.
Clean up...
Disk Cleanup
Are you sure you want to delete all but the most recent restore point?
If you have several saved restore points, you might not need the older ones. You can save disk space by deleting them.
Delete
Cancel
Local Disk (C:) Properties
Security
General
Previous Versions
Tools
Hardware
Type: Local Disk
File system: NTFS
Used space: 23,211,569,152 bytes 21.6 GB
Free space: 42,392,584,192 bytes 39.4 GB
Capacity: 65,604,153,344 bytes 61.0 GB
Drive C:
Compress this drive to save disk space
Allow files on this drive to have contents indexed in addition to file properties
OK
Cancel
Apply
Windows' Restore Points can quickly build up. Trash the old ones.

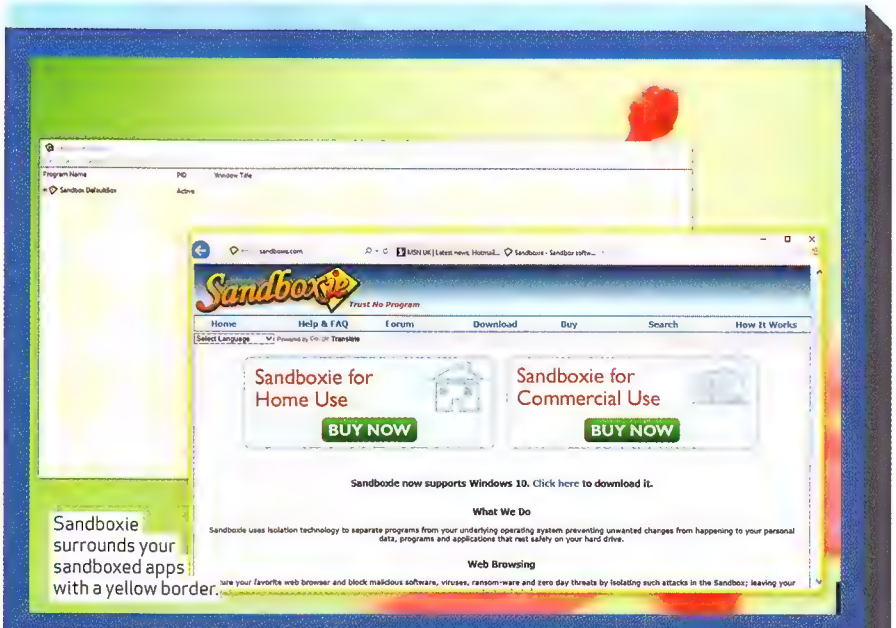
you like it or not. Copying files between partitions is also slower on spinning platter drives, due to the physical distance the read/write head needs to travel between the split areas of space.

You might think partitioning is something that can only be done to a clean system. That certainly is the easiest way to make it happen. As you run through the Windows installer, early on (if you don't choose the 'Upgrade' option) you're given the option of where to install Windows, at which point, you can also chop your disk up and format it as you see fit. We'd leave at least 32GB for Windows itself – if you're running an SSD and a magnetic drive in parallel, use the SSD for the operating system. Doing it this early is beneficial both in terms of instilling an ethos of organisation to your system and for speed – Windows won't need to shuffle itself around or be defragmented to make space for a new partition.

POST PARTITIONING

It's likely, though, that you're not going into this from scratch. And that's OK; Windows' own Disk Management tool (right-click the Start button, and select Disk Management) is all too happy to slice up the drives of any living system. Open it up, and you may see that what you thought was a simple drive actually consists of several partitions; we tried it on a laptop we had hanging around – one that had seen itself upgraded from Windows 8 to 8.1 to Windows 10 to the Anniversary Update – and found a host of recovery partitions and other empty space. It might be tempting, seeing this, to ditch this wasted space, but without knowing exactly what's on each partition, we advise that you tread very carefully.

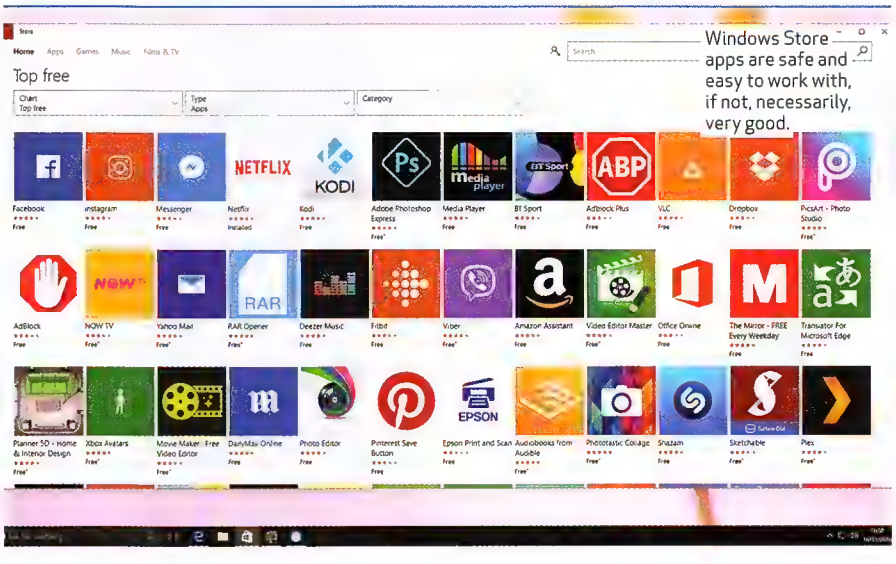
Find your main partition, or a partition you want to split, in the graphical representation. Right-click it, and select 'Shrink partition' to begin the operation of creating some empty space. It's here that you'll see just how much you're allowed to shift; so-called 'unmoveable' files put a damper on this in a hurry, but this problem can often be sorted by (temporarily) disabling System Restore or running Disk Cleanup. You can shrink your main partition down to the individual megabyte, but be sure to leave a reasonable amount of space free on your Windows partition in order that it can accommodate system updates and virtual memory. Once the shrink operation is complete, create your new partition or partitions by right-clicking the now unallocated empty space, selecting 'New simple volume', and allocating your desired amount of space, repeating the process for each new partition you wish to create.



Sandboxing applications

The Windows Store is clever. It shuts its apps away in their own little capsules, protecting your computer from rogues, and from the influence of anything untoward that may be swimming around your OS. Most standard Windows apps, though, don't have this facility. Unless, that is, you add it yourself. Sandboxie (**www.sandboxie.com**) does exactly this. If you've grabbed something a bit sketchy and need to test it out without risk, you can install it within a sandbox to ensure it doesn't get its tentacles in. Running a web browser on a family PC? Run it via Sandboxie to prevent your kids from downloading awful PC gremlins, or to stop your mom from inadvertently 'upgrading' something she shouldn't. Nefarious threats such as CryptoLocker are completely negated by running a sandboxed browser, unless your mother somehow works out how to store her important documents within the sandboxed folder structure – that's behaviour you need to curb on your own, though. Once you've set it up, you can open your sandboxes (through the app) as standard folders using Explorer.

Sandboxie can be used for free, though you get a nag screen after 30 days, and miss out on a few features only available to subscribers – if it's something you use regularly, you can sign up for $20.95 per year. There's a secondary benefit to all this, too: Sandboxie tucks all of the data from a program away in a single contiguous chunk of hard drive space, meaning deleting a sandboxed app doesn't leave the same fragmented storage you might get after uninstalling a regular program. It's a very minor thing, and there's every chance you're not even slightly worried by the behind-the-scenes goings-on of your data, but a well-organised drive is a fast drive.



CLEANING UP

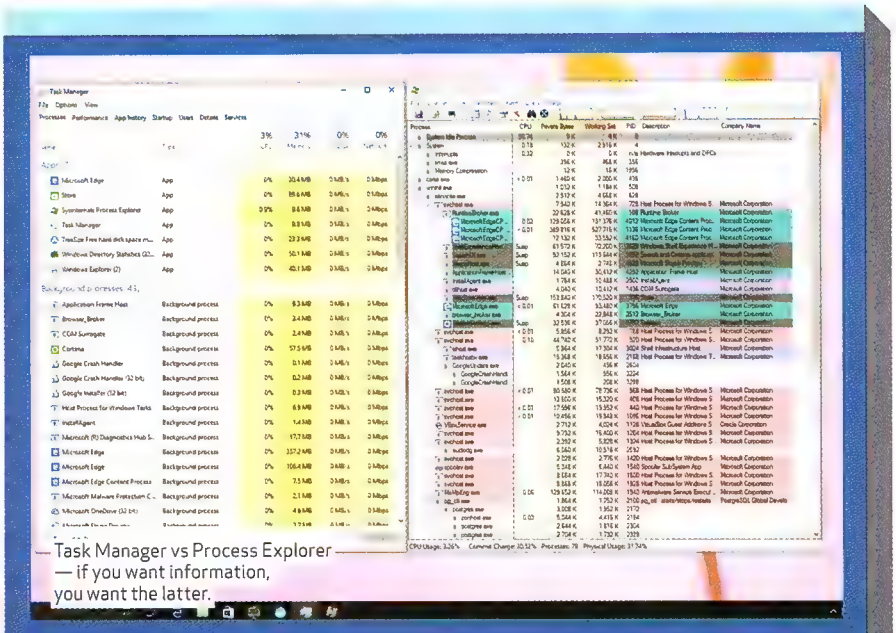
Where, oh where does the space go? An established system tends to eat up hard drive bytes rather mysteriously, and if you're obsessive about watching your drive stats, you may be wondering what's going on. We can't tell you precisely, although there are a few obvious culprits to look for if you're getting too low for that big app install.

First, and most prevalent, is System Restore points. These have the potential to be huge on their own, but if you're doing frequent installs, your Windows system may be making loads of them, and keeping a needless archive. Disk Cleanup helps you delete all but the most recent. To find the option, open up an Explorer window, right-click your OS partition (or just your C: drive), select 'Properties > Disk Cleanup > Clean Up System Files', then head to the 'More Options' tab. Disk Cleanup can also clean up temporary files and the like, although you may not save a vast amount of space this way.

So where are the hogs? The best way to find out is to use a visual method, rather than poking through Windows Explorer poring over file sizes. For this, you have two primary choices – TreeSize Free (**www.jam-software.com/treesize_free**) and WinDirStat (**windirstat.net**). TreeSize feels very much like a natural extension of Windows Explorer. Install it, and it runs from a context menu; right-click a folder or drive, fire it up, and it very quickly trawls through and finds out exactly what's inside, offering you the option of reopening as an administrator if any of your files are locked down. It then lists your folders by their size, with a handy bar graph indicator in the background. Drill down into the largest folders and you'll find your files – you can right-click them for a standard Explorer context menu, but be careful not to delete anything you don't explicitly know the meaning of.

WinDirStat is a similar tool, but infinitely cooler in that it ramps up the visual finery to a huge extent. Give it a run, select your drive (or 'All local drives' if you want to be unnecessarily thorough), then wait as it laboriously traverses your disk in search of meaty files – it's certainly nowhere near as fast as TreeSize.

When it's done, though, you'll see the benefit: a colour-coded map of your entire drive, with rectangles representing the size of files, collected into larger rectangles that represent folders. Click a big file and check the status bar to see exactly what it is and right-click to find a context menu that will help you open the folder in Explorer or copy its path to your clipboard. Click a folder or file in the top left pane, and it highlights it in the

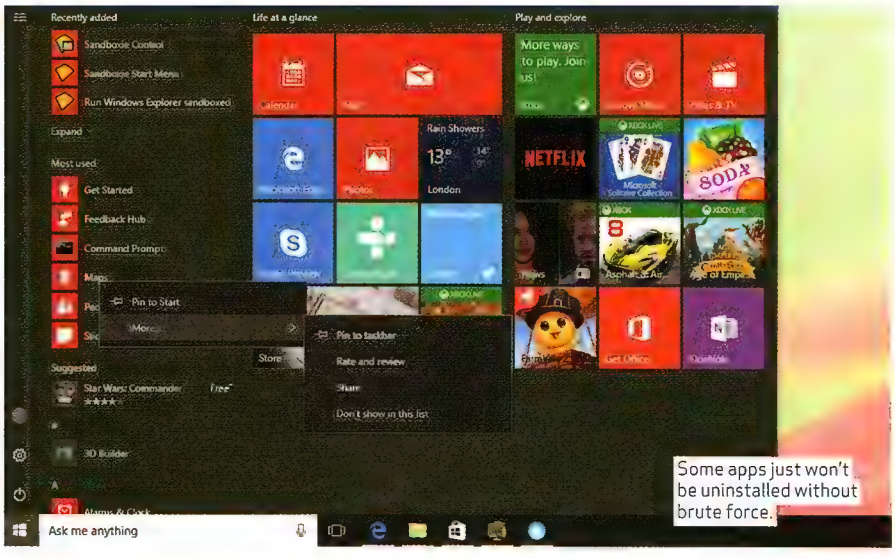


Task Manager vs Process Explorer – if you want information, you want the latter.

Finding resource hogs

Although we've mainly had our eyes set firmly on your hard drive in this feature, your applications don't just take up space there. Certain programs can have a disastrous negative effect on the overall running of your system, and might even be running on your system without your knowledge. Task Manager can do a pretty good job of showing you what's going on; hit 'Ctrl-Shift-Esc' to open it, then 'More Details' to see a categorised list. Right-click the column headers, select 'Type', then click it to sort the apps in the list, and have a look through to see what's running. Keep an eye out for things that hog your CPU, memory and disk access, and look at the Performance tab for a graph of the usage of these elements over time. The Details tab can offer a bit more insight into exactly what everything in the Processes tab is actually supposed to do. Do a full reboot of your system, reopen Task Manager, and have a good look at what's running and for anything you wouldn't expect to be there had you not opened it yourself. In all likelihood, it's there because of some autorunning application, so head to the Start-up tab, and disable any items you don't feel you need. This can often make programs load a little slower – they have to load these components at run time, instead of them being ready when you boot your PC, but they can always be enabled again at a later time if you notice a problem.

Spying on running software can get rather addictive, and it's fully possible to delve even deeper than the Task Manager allows. Try Process Explorer (**tinyurl.com/apc438-process**), one of the Microsoft Sysinternals tools, to see what's happening on your system in ridiculous detail.



Some apps just won't be uninstalled without brute force.

visual view, or use the top-right pane to hunt down files of particular types. They're listed, by default, in order of the size those files take up, so it's a good way to discover the space-munching culprits.

TIME TO UNINSTALL

Once you've found the monsters – or when you're simply done with your apps – how do you remove them? You might be surprised, but we're going to suggest that the best way to clean up an old app is by using Windows' own built-in interface, which you can find in the 'Programs and Features' section of the Control Panel. Removing files using this tool automatically fires up their included uninstaller (or, in the case of MSI-installed components, the Windows built-in equivalent), which should mean all trace of the app is wiped away. Make sure, if using this method, that you remember to check any boxes that also remove settings files or equivalent because, while they're not going to take up much space, any redundant files you leave on your drive slow down indexing and basically irritate you to no end.

If you're a fan of overkill and salting the earth, try a tool such as IOBit Uninstaller (**www.iobit.com**). It's available as a portable app from **portableapps.com** (because if anything should be, it's a tool that helps you get rid of installed software), and it's a great way of making sure every trace of an app is removed. Set it to work, and it bangs through your registry and filesystem to find files traditional uninstallers might have missed.

Super removal

Uninstalling apps you've installed in your PC is one thing. Getting rid of the dead wood that Microsoft includes by default in Windows is another. It doesn't look easy – there's not a normal, obvious way to remove those horrible, redundant entries from the Windows 10 Start menu. At least, it's not obvious at first glance, but there's a sneaky secret built in to the OS. Right-click on a Windows app in the Start menu (or any of the apps that can't be changed or uninstalled in the normal way) and, if it can be easily got rid of, an 'Uninstall' option is present in the context menu. But what of the rest of apps that can't be changed or uninstalled in the normal way?

For this you need PowerShell, the super command line that's bundled with Windows. Find it in the application list, right-click it, select 'Run as administrator', then type the following to remove (in this example) 3D Builder:

```
Get-AppxPackage *3dbuilder* | Remove-
AppxPackage
```

This uses Get-AppxPackage to look up the application's package, then pipes its location and information to the Remove-AppxPackage tool that strips it away. The asterisks can be replaced with the specific package name for a host of applications, though these aren't immediately obvious, so here's the full list:

- 3D Builder: *3dbuilder*
- Alarms and Clock: *windowsalarms*
- Calculator and Mail: *windowscommunicationsapps*
- Camera: *windowscamera*
- Groove Music: *zunemusic*
- Maps: *windowsmaps*
- Movies & TV: *zunevideo*
- OneNote: *onenote*
- People: *people*
- Phone: *photo*
- Store: *windowsstore*
- Voice Recorder: *soundrecorder*
- Xbox: *xboxapp*

If a program doesn't appear to be installed – as in, it doesn't appear in 'Programs and Features' – you can also point IOBit Uninstaller at its executable file, and it does its best to do an automatic uninstall. It's not flawless, but it's pretty damn good. ■

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

SECURITY

EXTRA CLOUD ENCRYPTION

I'd like to add another layer of encryption to my cloud storage account, but only for selected folders. What's the best way to do this?
John Derby

You could set up an encrypted container using VeraCrypt (get it from **veracrypt.codeplex.com**) inside which your most sensitive folders are stored. Keep a local, unencrypted copy of your files – just in case.

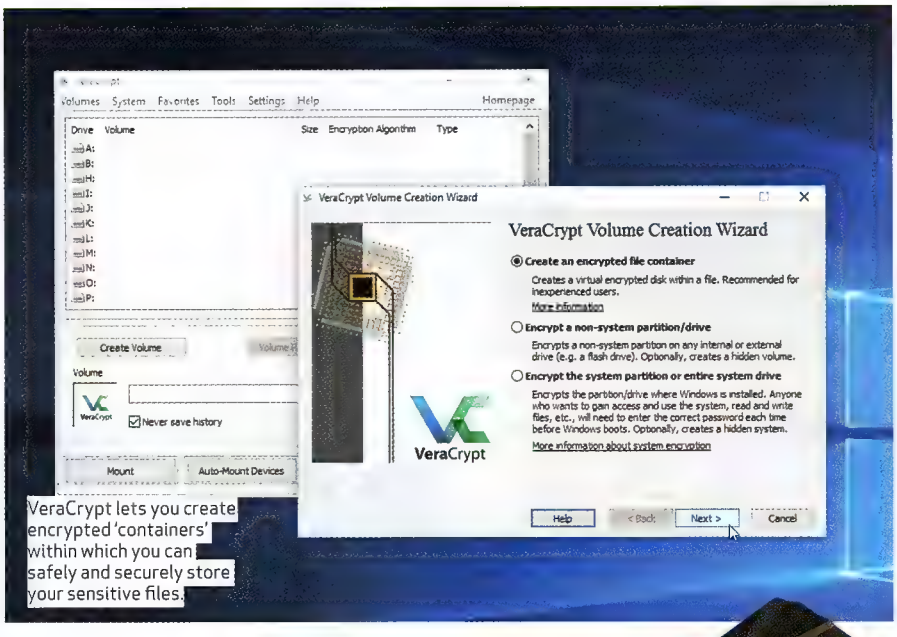
1. To start, open up VeraCrypt and then click 'Create Volume' > 'Create an encrypted file container' > 'Standard VeraCrypt volume'. Click 'Select File…' to choose a location within your cloud storage folder, and give it a suitable filename.

2. Using the default encryption options should be fine, so click Next. Set a suitable volume size large enough to contain all the files and folders you plan to store in here, then set your security (password, plus an option for a key file).

3. Now we need to format the container. Choose a file type (FAT is the default, consider NTFS), then wiggle your mouse until the bar turns green. Click Format, followed by Yes and OK when prompted. Click Exit, then choose 'Select File…' to load your container.

4. Now select a drive letter and click Mount (or 'Auto-mount Devices' to mount on startup). Supply the password and – if applicable – key file and click 'Mount'. Once done, move sensitive files into the container for additional security.

Matt Hanson



VeraCrypt lets you create encrypted 'containers' within which you can safely and securely store your sensitive files.

HARDWARE

PICK THE RIGHT GPU

I recently built a new PC for gaming (I play* Fallout 4, Witcher 3, XCOM 2, *and* Skyrim*) and web browsing (YouTube, Kodi, and so on). It's based on an ASUS Sabertooth Z170 Mark 1, Intel's Core i7-6700K at 4GHz, 16GB of Corsair DDR4 memory, a Samsung 850 EVO 500GB boot drive, a Seagate 1TB SSHD for loading games on, and an EVGA SuperNOVA 850 P2 PSU. The Intel HD Graphics 530 engine in the Core i7 scores 7.1 in the Windows Experience Index, which is 0.4 points higher than the Radeon R9 290 2GB in my A10-based machine, even though it wouldn't run* Fallout 4. *The CPU scores 7.8 and the memory/boot drive both score 7.9. I'd like the video card I buy to get as close to 7.8 as possible. So, I'm looking for a 4GB card in the $300 to $500 range that can handle my current and future games, including* Hitman, Mass Effect Andromeda, The Elder Scrolls Online, *and* Star Citizen. *Which would you recommend for my system?
Jon Poole

If you have around $350 to spend, the 6GB version of the GeForce GTX 1060 is our current pick.

First off, don't worry too much about those WEI scores. Your Radeon R9 290 is hands-down a better piece of graphics hardware than the integrated HD Graphics 530. The Windows System Assessment Tool runs several DirectX 9 and 10 graphics tests, along with benchmarking Windows Media encode and decode performance. Certain subtests likely favor Intel's hardware, particularly since that powerful AMD Hawaii GPU is almost certainly hamstrung by your A10 APU (regardless of the A10's operating frequency, its performance is more comparable to Intel's Core i3 family).

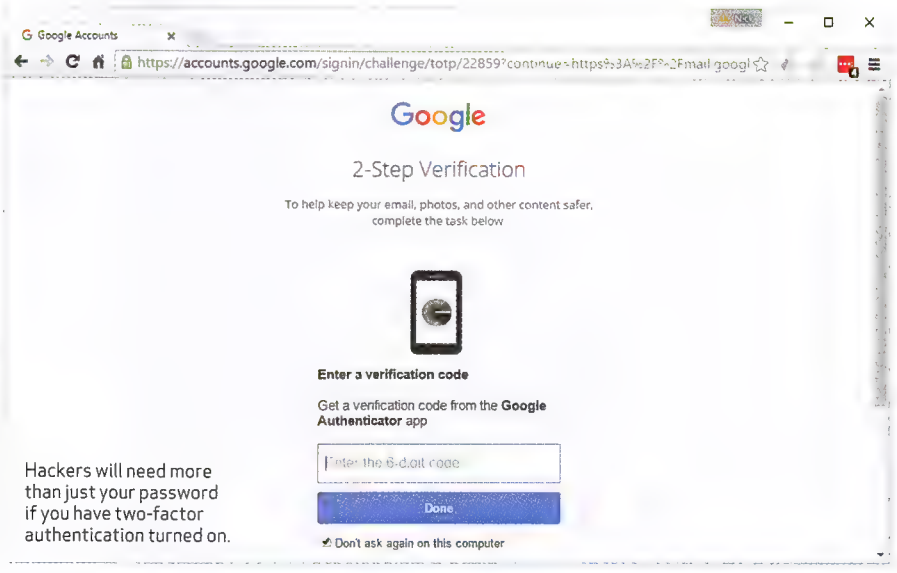
Before you sink another $300 to $400 on a new graphics card, try that R9 290 in your new build. We're willing to bet it'll feel a lot smoother in that faster Skylake-based machine, right up to 1,920 x 1,080. If you plan to game at higher resolutions, then you'll want a 4GB card, at least.

A GeForce GTX 1070 is definitely out of your price range, and the 4GB Radeon RX 470 and 3GB GTX 1060 are actually now both available for a little less than $300. That said, if you have closer to $350 to spend, then a 6GB GeForce GTX 1060 offers the best bang for buck at that pricepoint (if the old 290 doesn't do it for you).

APC team

SECURITY
TIGHTEN PROTECTION

I've read with concern the claims that a number of major cloud email providers – Yahoo, Hotmail and so on – have been hacked. Obviously we should all change our passwords, but what else can we do to protect ourselves?
Steve Hodge


Google Accounts
https://accounts.google.com/signin/challenge/totp/22859?continue=https%3A%2F%2Fmail.google
Google
2-Step Verification
To help keep your email, photos, and other content safer, complete the task below
Enter a verification code
Get a verification code from the Google Authenticator app
Enter the 6-digit code
Done
Don't ask again on this computer
Hackers will need more than just your password if you have two-factor authentication turned on.

Whether or not the claims are true, the recent news about so-called hacking of major companies is a wake-up call to us all. There are two key things you can do to add extra protection to your accounts. First, use randomly generated passwords that are impossible to guess. This works in conjunction with a password manager such as LastPass (**lastpass.com**) – try KeePass (**keepass.info**) instead if you'd prefer to store your passwords locally.

Second, log into your accounts and look for an option to switch on two-factor authentication. Whenever you – or anyone else – attempts to log into your account from an unknown PC, browser or device, a prompt to enter an authentication code will be flagged up. This is tied to a trusted device – typically your mobile phone – which has to be present to receive the code, either via text or using a trusted app like Google Authenticator. It means hackers can't get in even if they get your password.
Graham Barlow

HARDWARE
ACHIEVING 4K AT 60HZ

I've heard of people using 4K TVs with 60Hz support as monitors through the HDMI interface. I thought you could only do 4K at 60Hz with DisplayPort. Can you explain the details of whatever new version of HDMI makes this possible? Do you need a video card with special HDMI 2.0 ports?
Dan Winnette

There are a couple of ways to get 60Hz out of a 4K display, and both rely on available bandwidth. The first is DisplayPort, which you're familiar with. Version 1.2 offers a high enough data rate to support 3,840 x 2,160-pixels at 60Hz. That's the standard most of today's graphics cards expose. Version 1.3 and 1.4 support 4K monitors at up to 120Hz, and displays with those kinds of specs started to hit the market towards the end of last year. AMD's and Nvidia's current Polaris and Pascal GPUs (respectively) include DisplayPort 1.3-capable display controllers, and select models even have DP 1.4 support. Your alternative is HDMI 2.0, and yes, you need a graphics card that supports this. All of Nvidia's current 10-series GPUs and AMD's RX 400 cards support HDMI 2.0. However, you can also buy an active DisplayPort 1.2a to HDMI 2.0 adapter for roughly $50, so even selected older graphics cards can be made to play ball (if an entirely new card isn't an option).
APC team

OFFICE
OFFICE UPDATE ERRORS

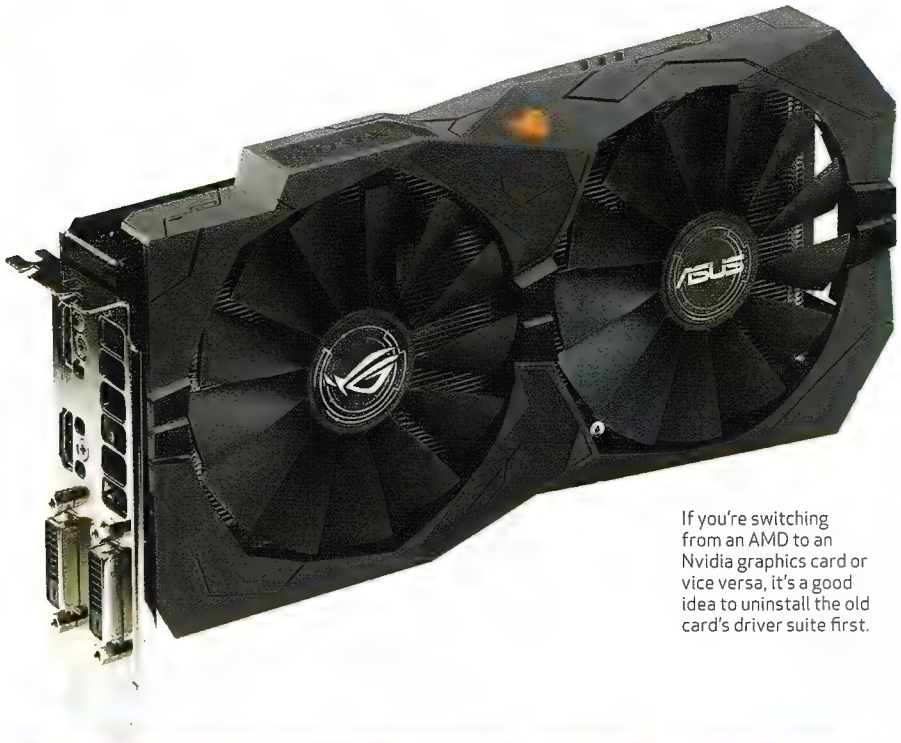
I'm pleased with my new Windows 10 PC, but looking under the update log in 'Settings', I see errors, such as Office XP Service Pack 3 (error 0x80096004). I've been using XP for years, but why is it not recognising I'm using Windows 10 rather than XP?
Terry Douglas

This sounds as if it was Office XP rather than Windows XP that was installed on Terry's system – this isn't rated compatible with Windows 10, so we're not sure how it was successfully installed. Terry subsequently revealed he was still using a HP iPAQ RX3000 PDA, which came with a copy of Outlook 2000 that he'd managed to install for syncing contacts from the device via Windows Mobile Device. Terry is willing to switch to Windows Live Mail if he can keep the contacts synced, but WMD only supports Outlook. As his current version still appears to work, we suggested leaving it alone for now and not worrying about the update error.
Nick Odantzis

HARDWARE
CONSTANT REBOOT AFTER UPGRADE

I replaced the monitor for my PC and transferred a more powerful graphics card into it from another computer I'd upgraded. However, since doing so, the PC annoyingly keeps rebooting every couple of minutes. Why is it doing this?! Hoping you can help?
Gail Rose

ASUS's PG27UQ is one of several available monitors to offer a resolution above 4K with refresh rates of 120Hz or higher.



If you're switching from an AMD to an Nvidia graphics card or vice versa, it's a good idea to uninstall the old card's driver suite first.

"Always uninstall your old graphics driver before shutting down and replacing the card — even if it's the same manufacturer."

We suspected that Gail may have swapped between NVIDIA and AMD graphics cards or vice versa without first uninstalling the old card. Sure enough, she revealed that the error message mentioned 'Catalyst Control Centre', a reference to the AMD driver software. Gail located and removed this from her PC and the error messages ceased. Always uninstall your old graphics driver before shutting down and replacing the card – even if it's the same manufacturer. Windows will automatically detect the new card and install the correct drivers for it.

Cat Ellis

HARDWARE

WHERE'S MY PRINTER'S INK ABSORBER?

I have a Canon Pixma IP3300 and I cannot clean the print head because it tells me that the ink absorber is almost full.

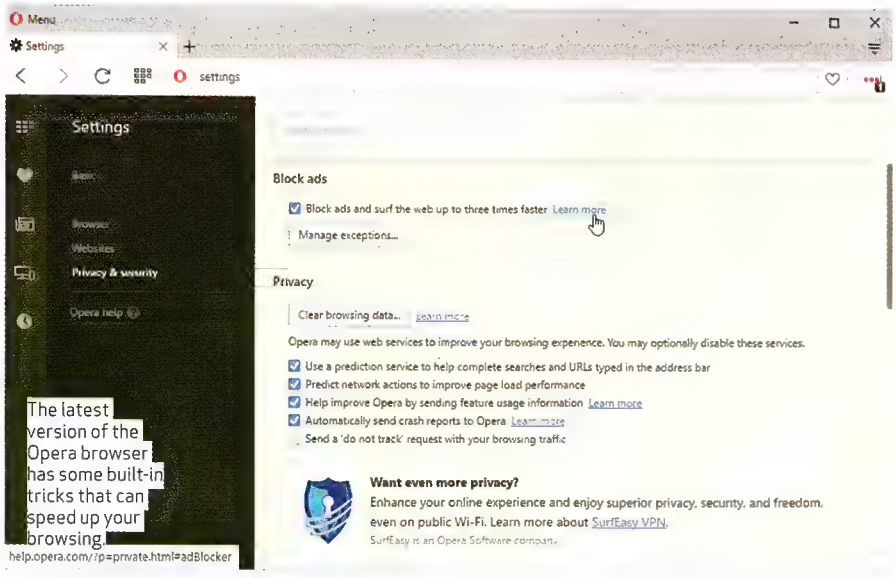
The manual tells me nothing — how do I empty or replace the ink absorber?
Jim Duncan

Ink absorbers are small, spongy pads that are found in a black rubber frame under the ink cartridge assembly. Their job is to absorb any excess ink that might accumulate during printing and cleaning of the print heads.

Canon recommends you get your printer serviced, but if you're feeling bold you can replace or even rinse them out yourself. Access them by opening the ink cartridge compartment, then wait for the cartridges to move all the way over before disconnecting the power cord. Now carefully extract the rubber frame and remove the absorbers from this. Replacements are a bit hard to come by in Australia, so check eBay, try an overseas option (we found some at **www.thesuppliesshop.co.uk**), or you can try cleaning them yourself. Make sure you're wearing rubber gloves, then place the ink pads in a bowl of warm, soapy water. Rub and squeeze the pads to remove the ink – you'll probably need to replace the water several times until all the ink is removed. Once done, squeeze any excess water from the pads and place them to dry on a stack of paper or kitchen towels, replacing any that become saturated. Once dry, place them back in the rubber frame, and fit that back in the printer, then press and hold the power button while reconnecting the power cord. Release the button for five seconds when power comes on, then push it again to reset the printer and remove the error message.

Cat Ellis

If you're careful, you can rinse out the ink absorbers on your Canon printer yourself.


Menu
Settings
settings
Settings
Block ads
Block ads and surf the web up to three times faster Learn more
Manage exceptions...
Privacy
Privacy & security
Opera help
Clear browsing data... Learn more
Opera may use web services to improve your browsing experience. You may optionally disable these services.
Use a prediction service to help complete searches and URLs typed in the address bar
Predict network actions to improve page load performance
Help improve Opera by sending feature usage information Learn more
Automatically send crash reports to Opera Learn more
Send a 'do not track' request with your browsing traffic
Want even more privacy?
Enhance your online experience and enjoy superior privacy, security, and freedom, even on public Wi-Fi. Learn more about SurfEasy VPN.
SurfEasy is an Opera Software company
help.opera.com/?p=private.html#adBlocker
The latest version of the Opera browser has some built-in tricks that can speed up your browsing.

Oculus generally recommends upper-midrange hardware for the best VR experience. You might want to aim even higher, though.

INTERNET

SPEEDING UP RURAL INTERNET

I recently moved to a rural area constantly have to deal with very poor browsing speeds. Is there any way to boost my connection?
Ian Parker

There is, and it won't cost you a cent. The Opera browser (**www.opera.com**) has a couple of built-in tools you can use to ensure your browsing is as fast and efficient as possible. Once you've got it installed, follow these steps.
1. Click the Menu button and select 'Opera Turbo' – this setting ensures any web pages you request are first sent to Opera's own servers where they're compressed. These smaller pages are then sent to your PC where they load quicker.
2. Opera also features ad-blocking technology to speed up page loading by leaving out potentially bandwidth-sapping adverts. You should be prompted to switch it on, or you can do so via 'Menu > Settings > Privacy and Security'.
3. Many content-driven sites depend on the income from ads to survive. After visiting a site, click the blue shield icon in the Address Bar to review how many ads are blocked – click the 'Speed Test' link to see how much time is saved.
4. If the site loads quickly even with ads, we recommend you whitelist it – this means ads will only load on that site in future. It ensures the site receives much-needed revenue, while penalising those sites that are plagued with slow-loading adverts.
Nick Odantzis

HARDWARE

VR FOR VIRTUAL TRAVEL

I've been a subscriber to your mag for a number of years and greatly enjoy it, even though I am not into gaming. I am, however, quite interested in VR/AR. This is more from the perspective of immersive travel experiences.
I am ready to buy or build a new PC now, and initially use integrated graphics. Eventually, I'd like to add a discrete GPU, as the strongest performer in AR/VR apps emerges over the next year or two. Today's on-die solutions are quite sufficient for my daily needs (I easily get by now with an old Core 2 Duo E6750/ Radeon HD 3650 combination). If it were not for AR/VR, I would most likely be pursuing a more compact PC.
Guidance for an office-oriented machine, future-proofed against AR/VR requirements, would be appreciated.
John Roling

Enthusiasts have (finally) witnessed the dawn of virtual reality over the last year and the hardware world continues to marches on at its familiarly furious pace, while VR/AR platforms continue to take shape. Thus, it's difficult to predict what a future-proofed machine will look like during the tumultuous birth of an industry, aside from "as high-end as possible".

Even though your interest is immersive travel – what many might consider an educational experience – don't expect drastically relaxed hardware requirements. Browsing through the titles showcased on **http://share.oculus.com**, virtual exploration of the Roman Colosseum, GE's Subsea Experience, and up-close encounters with dinosaurs all call for GeForce GTX 780 Ti or higher graphics cards, while more recent additions simply cite Oculus's 2016 recommendations.

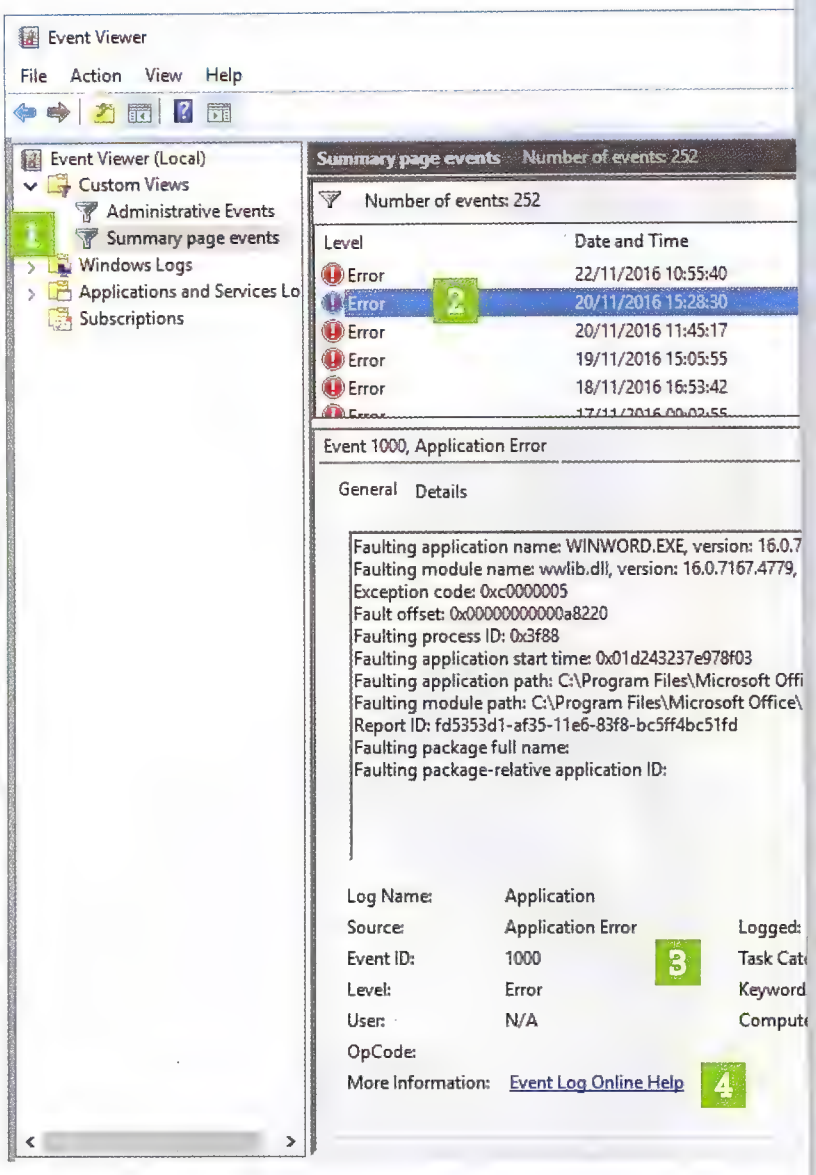
So, whether you plan to game or not, prepare for the VR experience by buying a system with at least a Core i5-6500, 8GB of RAM, and a GeForce GTX 1060 or Radeon RX 470.
APC team

Troubleshoot Windows crashes

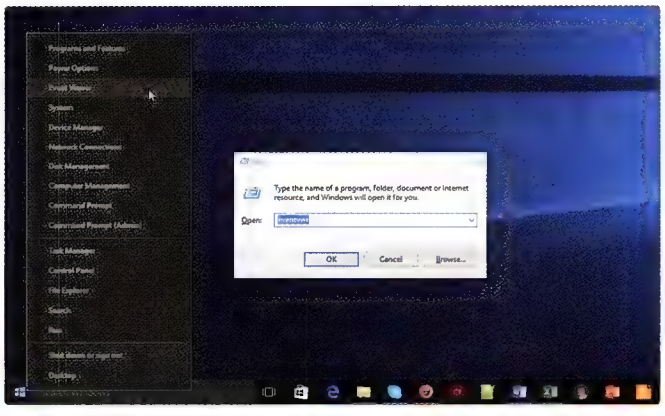
Take a look under the hood of Windows to track down the cause of stubborn problems with Nick Peers.

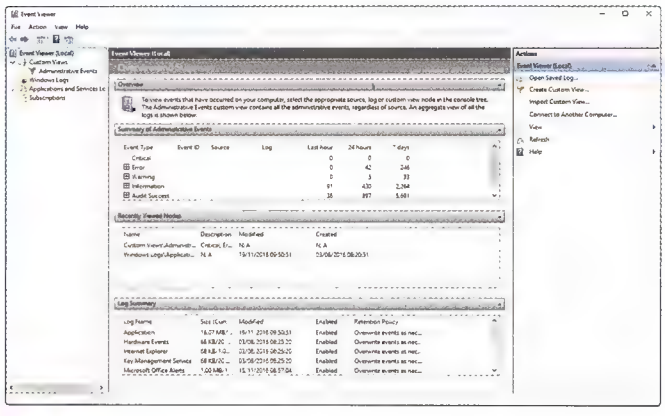
Why is it that your PC always seems to develop problems at the most inopportune moments? While Windows has largely been known to be pretty good at fixing its own problems, there are, of course, those frustrating times when its own built-in tools – from self-healing to troubleshooters – fail to do the job.

There's still no substitute for the self-help approach, and one of the best tools for this is the Event Viewer. It's where you'll find Windows' log files, a record of everything that's going on, including symptoms of problems both evident and still hidden away. By carefully examining these logs, you can find out what's causing all kinds of glitches, from obvious – if cryptic – error messages to more vague issues, such as sluggish behaviour or periodic freezes. Read on to discover how to decipher these logs and find a solution to your problem.



How to fix Windows with Event Viewer



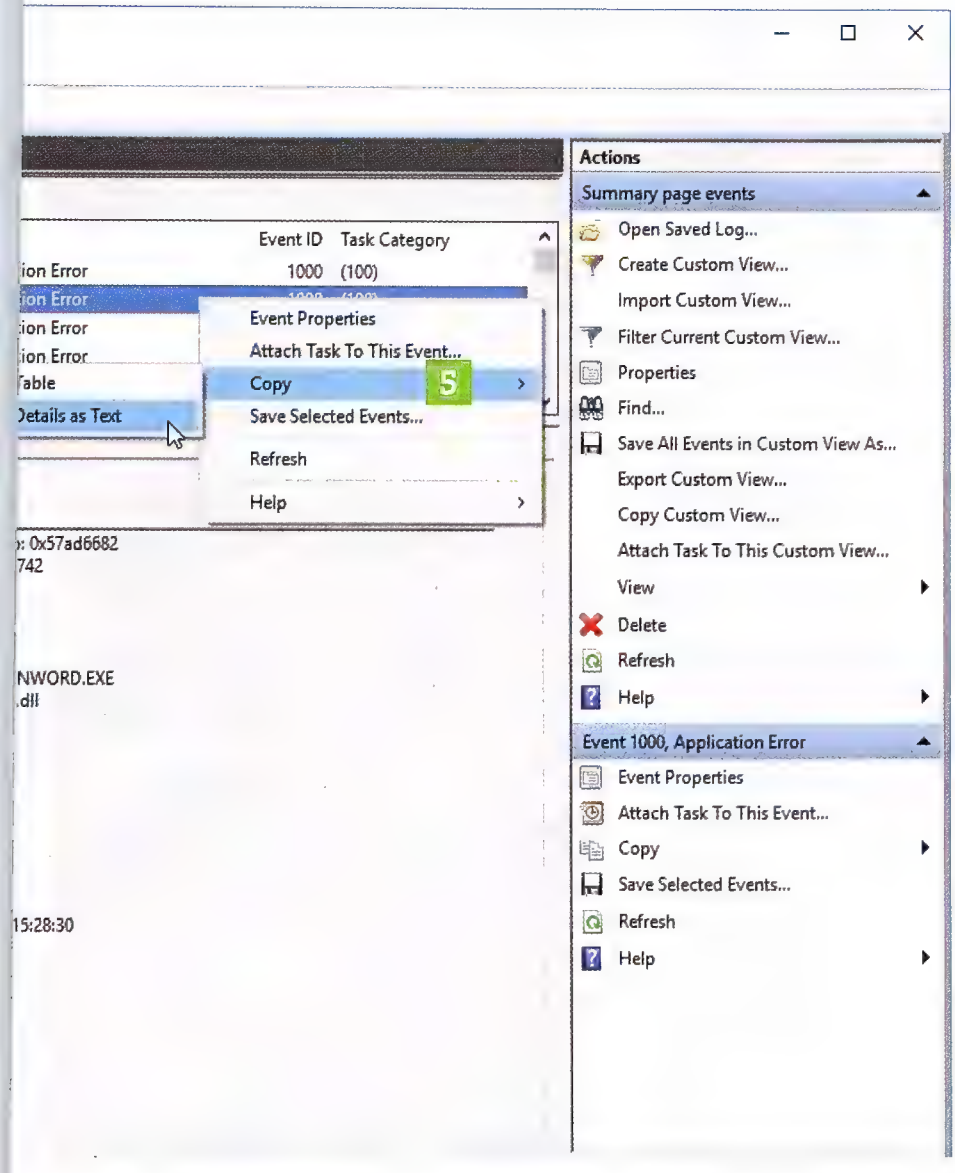


1 LAUNCH EVENT VIEWER

If you're running Windows 8 or 10, the simplest way to open Event Viewer is to press 'Win-X' or right-click the Start button and select it from the Quick Access menu; if you're running Windows 7, press 'Win-R' to open the Run dialogue box, then type "eventvwr" and press Enter. If prompted by User Account Control, click 'Yes' or 'Continue'.

2 GET A SUMMARY

The main Event Viewer screen will appear. The middle pane should display three sections of information: concentrate on the 'Summary of Administrative Events' section at the top, which displays a list of each type of event logged in the past hour, 24 hours and seven days. Pay particular attention to 'Critical', 'Error' and 'Warnings' sections (but don't panic — yet!).



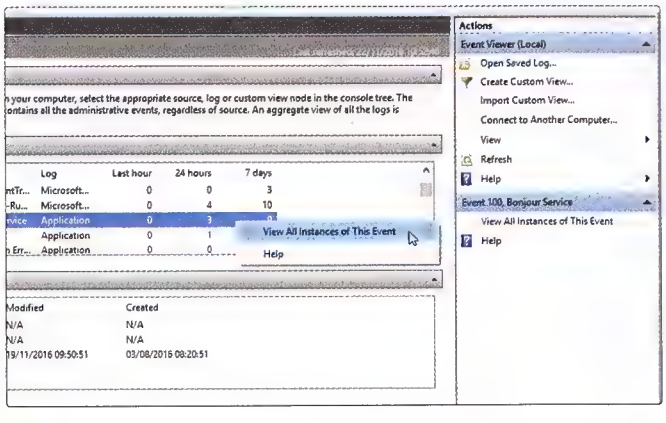
1 FILTER VIEW
You can examine specific parts of your system by browsing through the available list of logs or create custom views.

2 ERROR FREQUENCY
In some cases, errors and warnings can be ignored, but if they keep cropping up, it's a good idea to investigate them.

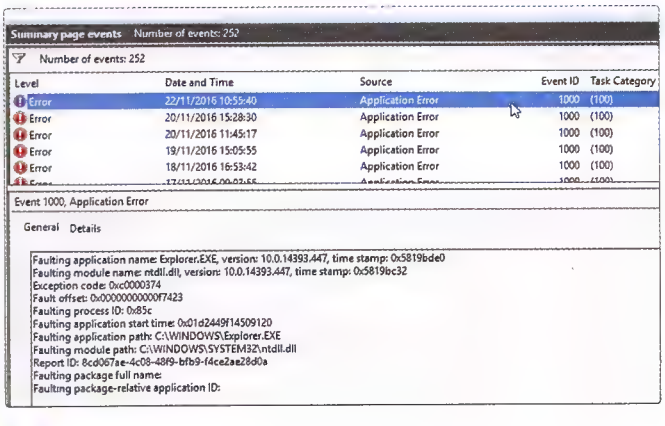
3 EVENT DETAILS
Try to include as much detail as the log gives you in your searches: Event ID, source (or file names) and any error codes.

4 SEARCH ONLINE
This handy link no longer works in Windows 10 — don't worry, we'll show you how enter your event details to find more advice.

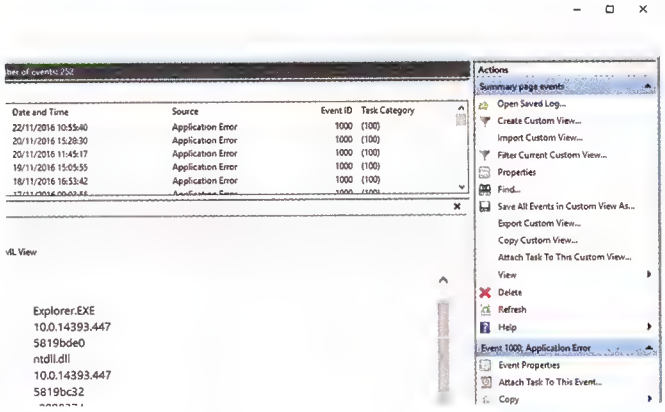
5 ASK OTHERS
If all else fails, right-click the event to copy its details to paste into an email or web forum post asking for help.



3 BROWSE EVENTS
Click '+' next to a section to expand it and view a summary of the events. Focus on event types that last occurred (within the hour, 24-hour or 7-day ranges) around the time your problem manifested itself. Double-click an event to open its Summary page, then use the annotation to help identify possible events that correlate to the problem you're investigating.

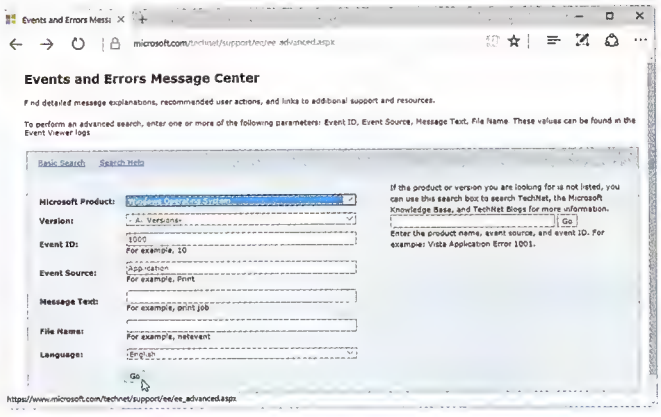

Summary page events Number of events: 252
Number of events: 252
Level Date and Time Source Event ID Task Category
Error 22/11/2016 10:55:40 Application Error 1000 (100)
Error 20/11/2016 15:28:30 Application Error 1000 (100)
Error 20/11/2016 11:45:17 Application Error 1000 (100)
Error 19/11/2016 15:05:55 Application Error 1000 (100)
Error 18/11/2016 16:53:42 Application Error 1000 (100)
Event 1000, Application Error
General Details
Faulting application name: Explorer.EXE, version: 10.0.14393.447, time stamp: 0x5819bde0
Faulting module name: ntdll.dll, version: 10.0.14393.447, time stamp: 0x5819bc32
Exception code: 0xc0000374
Fault offset: 0x000000000000f7423
Faulting process ID: 0x85c
Faulting application start time: 0x01d2449f14509120
Faulting application path: C:\WINDOWS\Explorer.EXE
Faulting module path: C:\WINDOWS\SYSTEM32\ntdll.dll
Report ID: 8cd067ae-4c08-48f9-bfb9-f4ce2ae28d0a
Faulting package full name:
Faulting package-relative application ID:

4 VIEW EVENT DETAIL
Review all instances of the event type, focusing on the time and date each instance occurred. This can help link the event to your problem, but go through all event types under 'Critical', 'Error' and possibly 'Warning' to see if there are multiple events linked to the problem. Make a note of each one, then read on to discover how to examine each one in more depth.



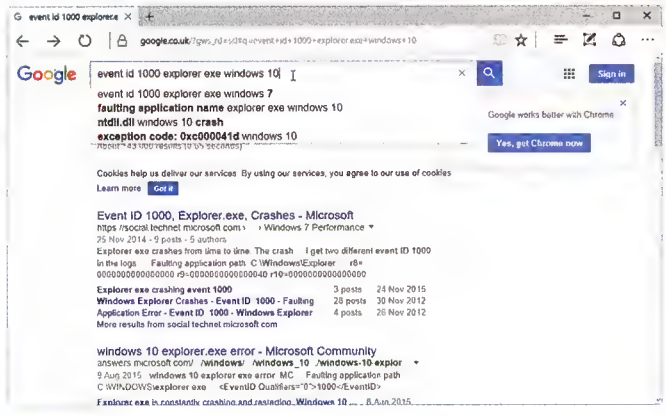
5 GET HELP ONLINE

Make a note of the description — the Details tab provides more technical data. You'll notice an 'Event Log Online Help' link at the bottom of the General tab, which, if you click, throws up the message shown — sadly, this doesn't work in Windows 10, but don't worry. Instead, open your browser and go to **www.microsoft.com/technet/support/ee/ee_advanced.aspx**



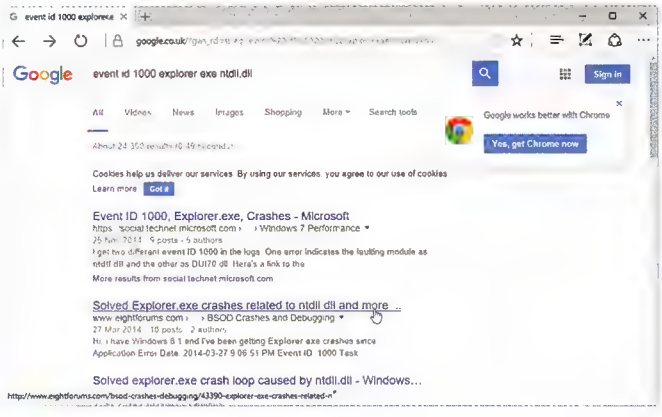
6 SEARCH TECHNET

Select 'Windows Operating System' for Microsoft Product, but leave '--All Versions--' selected. Type the Event ID number into the 'Event ID' box, and the same source as listed in Event Viewer (for example, 'Application') into the 'Event Source' box. Click 'Go' and a list of matching results will be shown. Click one to read more about the problem; if there are multiple entries, try them all.


Google
event id 1000 explorer exe windows 10
Event ID 1000, Explorer.exe, Crashes - Microsoft
windows 10 explorer.exe error - Microsoft Community

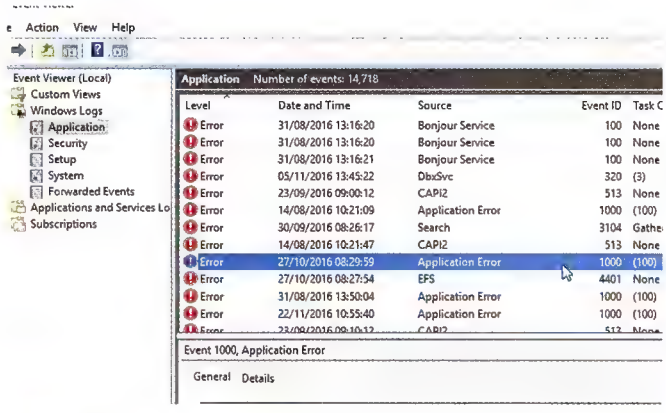
7 BROADEN YOUR SEARCH

TechNet may return no results (or simply return some generic information about the fault that doesn't really help). Don't give up, though. Make a note of the Event ID, Source and description under the General tab in Event Viewer, then type these into a search engine and see what results come up. You may find more troubleshooting information via a web page or forum.


Google
event id 1000 explorer exe ntdll.dll
Event ID 1000, Explorer.exe, Crashes - Microsoft
Solved Explorer.exe crashes related to ntdll dll and more ...
Solved explorer.exe crash loop caused by ntdll.dll - Windows...

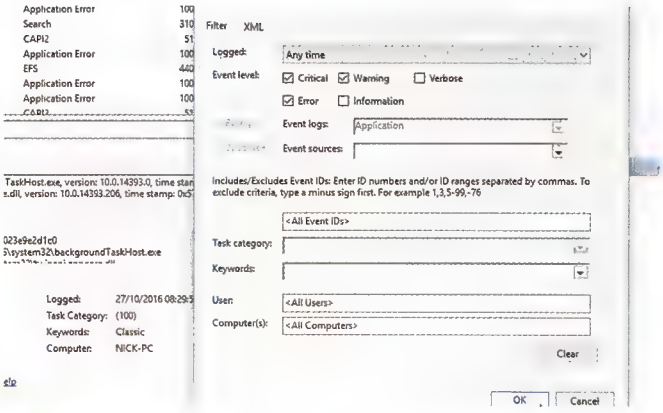
8 NARROW YOUR SEARCH

If too few results are returned, search for fewer words or omit the Source or Event ID from your terms. If too many results come back, narrow it by including more information. Include specific references to filenames in the event log, for example, or provide more general information, such as your version of Windows, hardware device or software program.


Action View Help
Event Viewer (Local)
Custom Views
Windows Logs
Application
Security
Setup
System
Forwarded Events
Applications and Services Lo
Subscriptions
Application Number of events: 14,718
Level Date and Time Source Event ID Task C
Error 31/08/2016 13:16:20 Bonjour Service 100 None
Error 31/08/2016 13:16:20 Bonjour Service 100 None
Error 31/08/2016 13:16:21 Bonjour Service 100 None
Error 05/11/2016 13:45:22 DbxSvc 320 (3)
Error 23/09/2016 09:00:12 CAPI2 513 None
Error 14/08/2016 10:21:09 Application Error 1000 (100)
Error 30/09/2016 08:26:17 Search 3104 Gathe
Error 14/08/2016 10:21:47 CAPI2 513 None
Error 27/10/2016 08:29:59 Application Error 1000 (100)
Error 27/10/2016 08:27:54 EFS 4401 None
Error 31/08/2016 13:50:04 Application Error 1000 (100)
Error 22/11/2016 10:55:40 Application Error 1000 (100)
Event 1000, Application Error
General Details

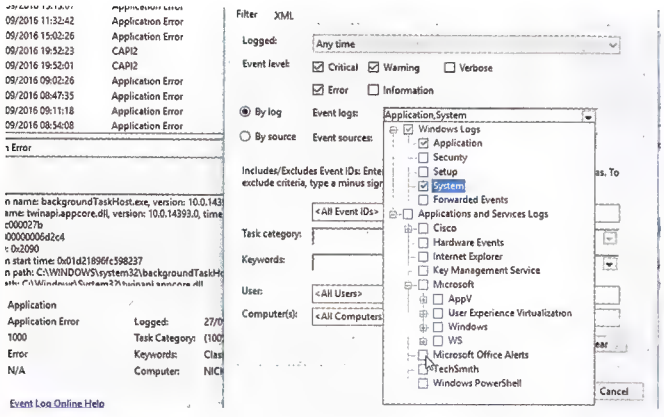
9 BROWSING LOGS

What happens if you can't find the information you're looking for? It's likely the events you need to track are buried away. Manually browse the logs to narrow your search. Expand 'Windows Logs' in the left-hand pane where you'll find logs in categories. Use Applications to search for program-related problems, and System for Windows and hardware.



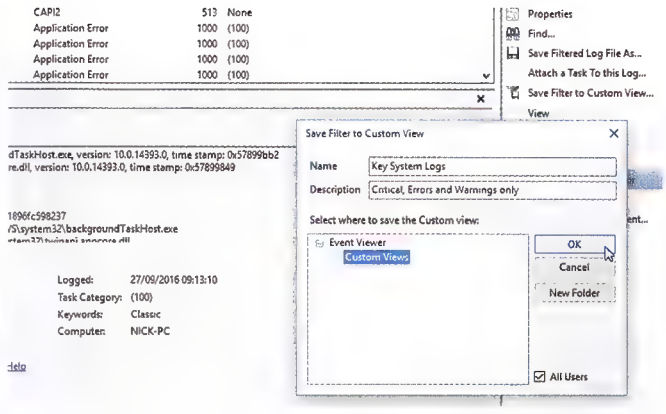
10 FILTER LOGS

Logs record all manner of information, much of it irrelevant — at least when troubleshooting a problem. Click the 'Filter Current Log' button in the right-hand pane to filter the list a number of different ways: by the time it occurred, the type of event (focus on critical, error and warning), Event sources, IDs, keywords or any combinations. Click 'OK' when done.



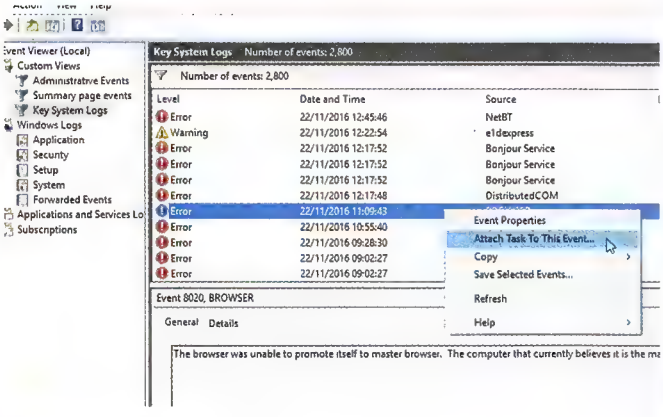
11 CREATE A CUSTOM VIEW

If you want to create a filter that provides you with information across multiple logs, or wish to create a filter you can easily access in future, click 'Create Custom View' under 'Actions'. It works in the same way as the filter — to monitor more than one log with your custom view, click the 'Event logs' dropdown menu and tick the logs you wish to include.



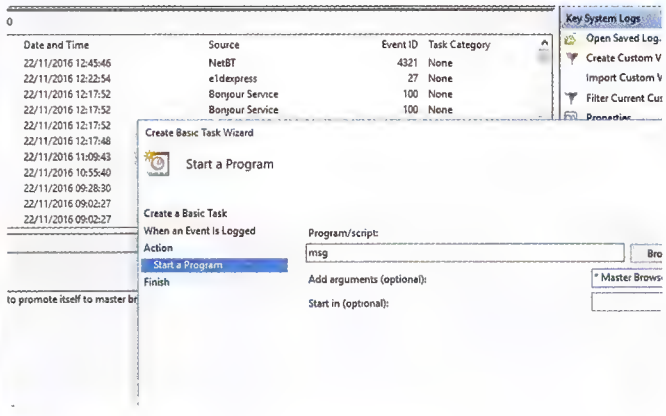
12 SAVE YOUR VIEW

Click 'OK', then give your custom view a suitably descriptive name and choose where to save it within the 'Custom Views' tree in the left-hand pane. Going forward, you'll be able to access this view at any time directly from here — it's the perfect shortcut for targeted troubleshooting that will take an extended period of time to monitor and act upon.


Key System Logs Number of events: 2,800
Level Date and Time Source
Error 22/11/2016 12:45:46 NetBT
Warning 22/11/2016 12:22:54 e1dexpress
Error 22/11/2016 12:17:52 Bonjour Service
Error 22/11/2016 12:17:52 Bonjour Service
Error 22/11/2016 12:17:52 Bonjour Service
Error 22/11/2016 12:17:48 DistributedCOM
Error 22/11/2016 11:09:43
Error 22/11/2016 10:55:40
Error 22/11/2016 09:28:30
Error 22/11/2016 09:02:27
Event Properties
Attach Task To This Event...
Copy
Save Selected Events...
Refresh
Help
Event 8020, BROWSER
General Details
The browser was unable to promote itself to master browser. The computer that currently believes it is the ma

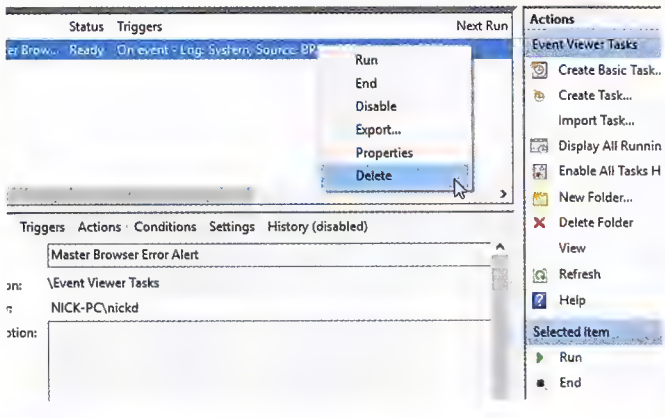
13 SCHEDULE ALERTS

Event Viewer also lets you create alerts that are triggered when specific events occur. This can be useful for troubleshooting underlying problems as you may find a seemingly unrelated event is triggering the error, or get early warning that something nasty is about to happen. Once you've located the event you wish to monitor, right-click it and choose 'Attach Task to This Event...'



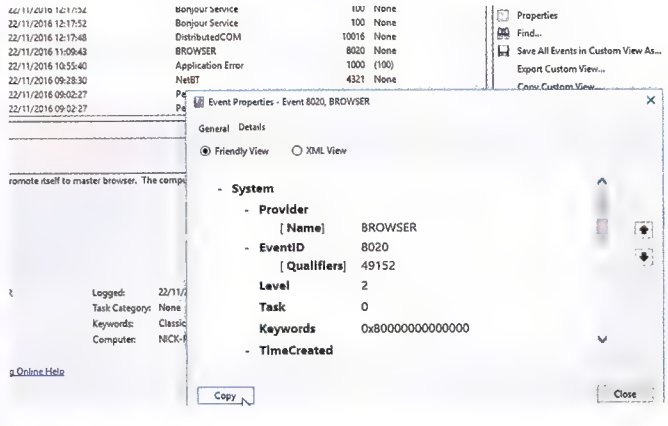
14 CREATE ALERT

Change the name to something that will help you recognise it in Task Scheduler (see next step), and click 'Next' twice. Neither email nor 'display a message' options work, so leave 'Start a program' selected and click 'Next'. Type "msg" into the Program/script box, then type "*" followed by your message (for example, "*Error Alert") into 'Add Arguments'. Click 'Next > Finish > OK'.



15 REMOVE ALERT

Eventually, you may no longer want that alert popping up (because you've fixed the problem!). To remove it, open Task Scheduler — type scheduler into the Search box and click 'Task Scheduler' when it appears, or press 'Win-R', type "control schedtasks" and click 'OK'. Expand 'Task Scheduler Library > Event Viewer Tasks', right-click the alert and choose 'Delete', then 'Yes'.



16 TROUBLESHOOTING MADE EASIER

Now you've discovered the basics of how Event Viewer works, you can use it to help you track down problems in the future. By examining your system logs using its interface, you should be able to locate the information you need to go out and not just diagnose what's ailing your PC, but also hopefully find a solution to bring it back to good working order, too. ■

Record a podcast using your iPhone or iPad

Learn how to record and edit a podcast in GarageBand with Gary Marshall.

GarageBand isn't just a great tool for musicians. It's also a radio studio, enabling you to record podcasts.

Some podcasts put a microphone in a room with interesting people, hit 'Record' and wait for the magic to happen, then upload the results with little or no editing work. Others are painstakingly produced, combining music and sound effects from all kinds of places. GarageBand is happy to work with either.

It's possible to record your voice using the microphone built into your iPad or iPhone, but you'll get better results with a dedicated microphone and a pop shield – a circle of fabric that sits between you and the microphone to reduce the noise of plosives, which are "puh" and "duh" sounds that can boom on recordings.

Unfortunately, there's no microphone socket on an iPhone or iPad, so you can't simply plug in a USB mic like you would with a desktop or laptop Mac. If your iPad or iPhone has a Lightning port, you'll need Apple's Lightning to USB Camera Adapter, which adds a USB port to the bottom of your device; if you have the older 30-pin connector, the dongle you want is Apple's 30-pin to USB Cable. Non-Apple versions of both items are widely available, but in our experience, the build quality isn't usually up to much.

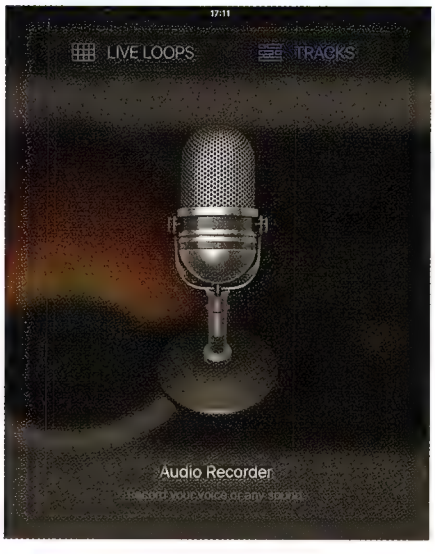
There's another problem: power. Many USB microphones need a lot of power, and iOS devices don't provide enough of it. You may need to connect a powered USB hub between your iOS device and the microphone. More elegantly, Apple's Lightning to USB 3 cable has a Lightning port next to the USB socket, so you can just connect your charger.

If you're new to podcasting, it's worth sketching out a plan of what you want to talk about in case you get tongue tied, but even if you do, don't worry. It isn't going out live, so you can fix problems at the editing stage before unleashing your podcast on the rest of the world.

> "If you're new to podcasting, it's worth sketching out a plan of what you want to talk about in case you get tongue tied."

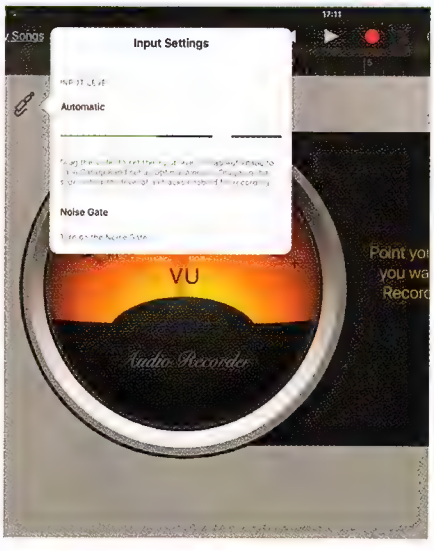
How to:

Make podcasts in GarageBand



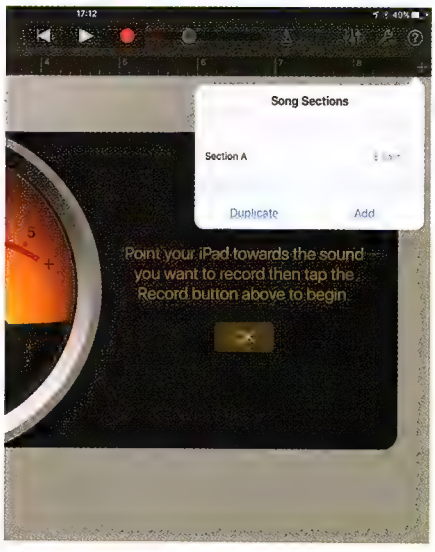
1 ROCK THE MIC

Connect a USB microphone if you're using one, open GarageBand and create a new song. Navigate through the instruments until you see the Audio Recorder, which enables you to record speech or instruments.



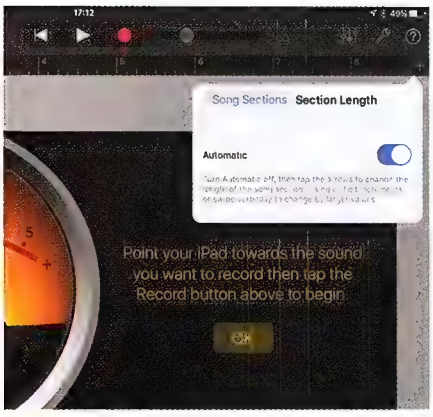
2 TURN IT UP

You'll see a little icon of a jack plug towards the top right of the window. Tap that to bring up the input level slider and adjust the volume. Enable the Noise Gate to shut off the mic when you're silent.


Song Sections
Section A
Duplicate
Add
Point your iPad towards the sound you want to record then tap the Record button above to begin.

3 GIVE IT ROOM

By default, GarageBand expects to record short clips. To change that, tap on the '+' icon at the right-hand side of the timeline. You should now see a window showing Song Sections. Tap where it says Section A: 8 Bars.

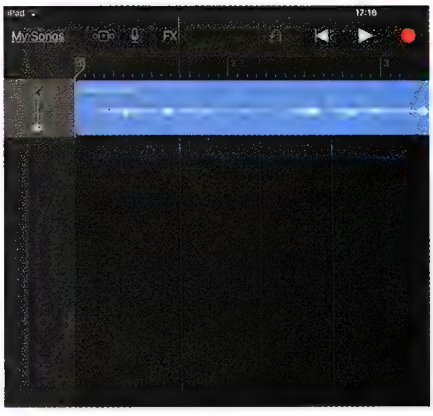

Song Sections
Section Length
Automatic
Point your iPad towards the sound you want to record then tap the Record button above to begin
OK

4 AUTOMATIC OPTION

If you choose the Automatic option under Section Length, the app won't stop recording you after 8, 16, or 32 bars: it'll keep going until you run out of words and hit the stop button (the square button at the top).

5 START TALKING

All you need to do now is to tap the red circle at the top of the window to start recording. The dial in the main bit of the window will move to show your volume level; try to keep it out of the red — audio becomes distorted at this level.

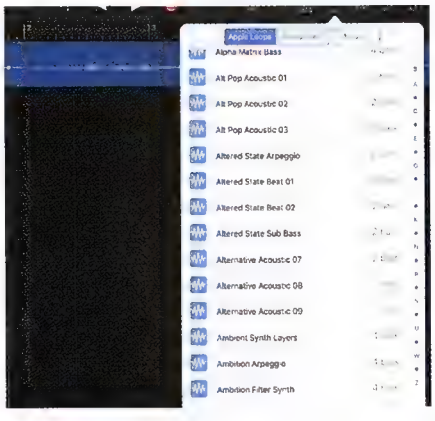


6 SEE YOUR SPEECH

When you've finished recording, tap on the Tracks button (third icon from the left at the top of the screen) and you'll see the Tracks View. The blue bit is the audio file you've just recorded. Tap on it for options.

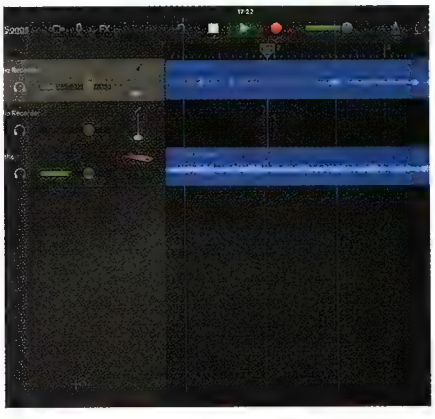
7 STOP, TRIM, RESTART

If you've made a mistake, you can just use the grabber at the right of the audio track and pull it back to shorten the recording. Now, tap the timeline at the point you want to restart and then hit record again.



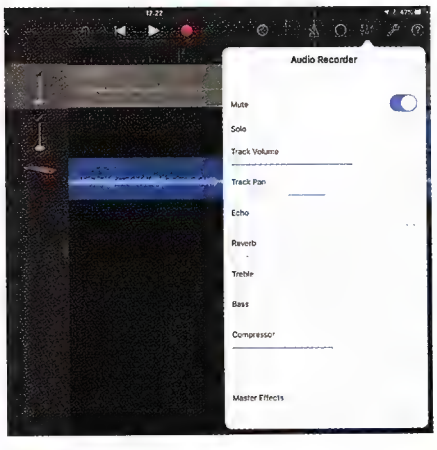
8 ADD AUDIO

You can add audio by tapping the loops icon, which gives you access to Apple Loops, audio files on your device or iCloud Drive, and Apple Music tracks. You can't add Apple Music songs you haven't downloaded and paid for.



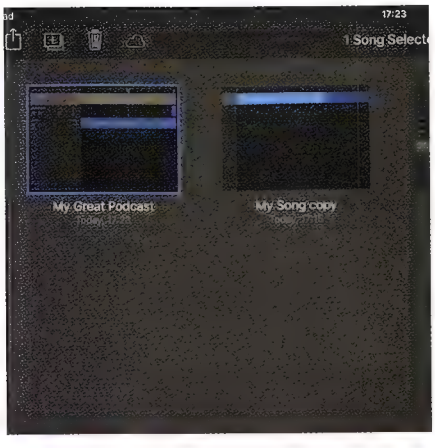
9 DROP THE BEAT

You can add a loop or audio file by simply dragging it from the list and into the main window. GarageBand then creates a new track, and you can add more tracks if you have multiple audio files to include.



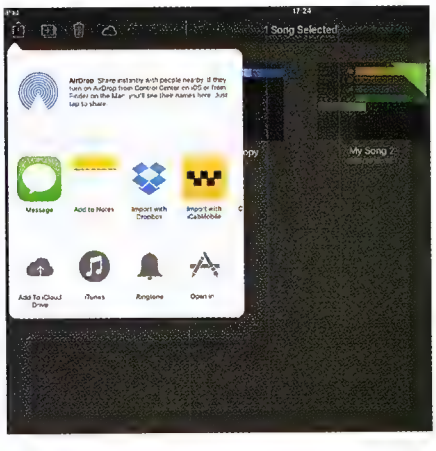
10 MIX IT UP

To adjust the relative position and volume of tracks, tap the mixer icon and you'll see options for volume, pan and special effects. The compressor's good for speech as it keeps the volume at a consistent level.



11 SAVE YOUR SPEECH

When you're finished, to save your podcast, tap on My Songs and you'll be returned to the main GarageBand library. Give your podcast a meaningful name, select it and then tap the share icon at the very top left.



12 TELL THE WORLD

GarageBand can transfer completed projects to iCloud Drive or to iTunes, and it also works with third-party services such as the popular SoundCloud. Just scroll through the Share sheet to see your options.

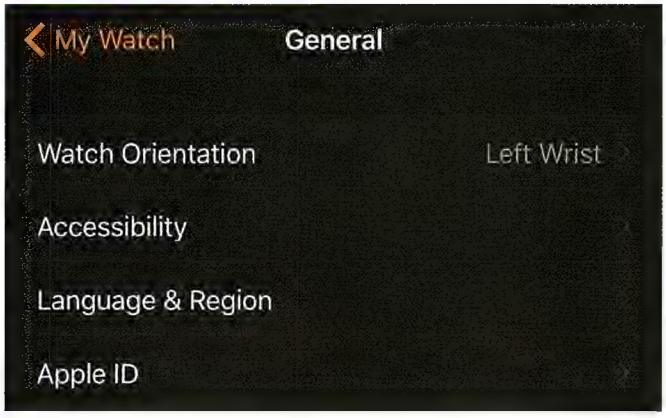
How to switch seamlessly across Mac and iOS devices

Alan Stonebridge shows how to make your Mac, iPhone and iPad work better together with these features.

Continuity is a group of six features that are available in the latest versions of iOS and macOS, and which provide extra convenience in certain scenarios. Two of these features – Auto Unlock and Universal Clipboard – are new. With the former switched on, when you wake your Mac, it checks for your Apple Watch nearby, and that the Watch is unlocked; if so, your Mac assumes it was you who woke it and skips its usual request for your password, taking you straight to your desktop. Universal Clipboard recognises that you may in fact be using more than one of your devices at the same time, and so its purpose is to enable you to copy and paste text, images or video from one device to another just by copying to the clipboard as you normally would.

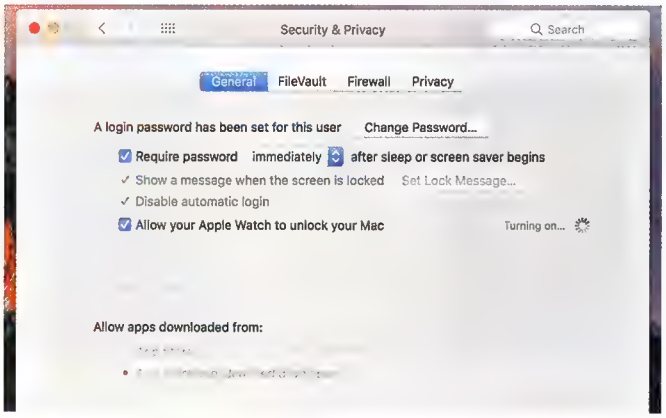
The remaining four Handoff features were added to Apple's operating systems some time ago. However, if you've been using a Mac that predates 2012, you won't have had the luxury of enjoying them, due to a lack of Bluetooth 4.0 in those earlier models. All of the Continuity features require participating devices to be signed in to your iCloud account, as proof of your identity. Most features also need Bluetooth and Wi-Fi to be turned on.

How to:
Use Continuity



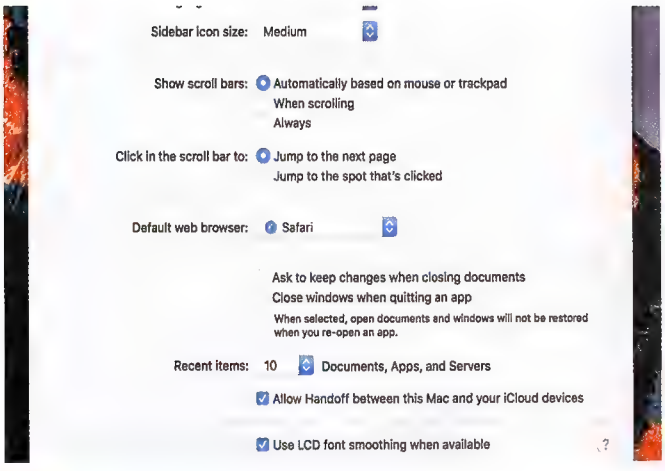
1 START WITH AUTO UNLOCK

Ensure your Mac's Bluetooth and Wi-Fi are on, then that your Mac and Watch are signed in to iCloud with the same Apple ID (go to > System Prefs > iCloud on Mac, and the Watch app > General > Apple ID on phone).



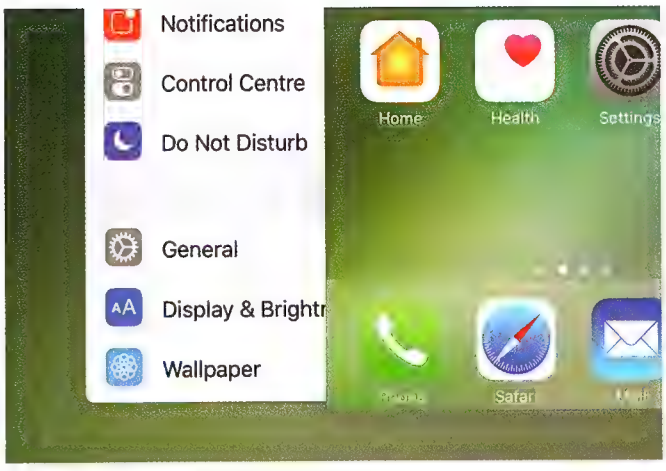
2 MORE AUTO UNLOCK

If you haven't already, set up a passcode in the Watch app > Passcode on your iPhone. In > System Prefs > Security & Privacy on your Mac, enable 'Allow your Apple Watch to unlock...' and wait for it to activate.


Sidebar icon size: Medium
Show scroll bars: Automatically based on mouse or trackpad
When scrolling
Always
Click in the scroll bar to: Jump to the next page
Jump to the spot that's clicked
Default web browser: Safari
Ask to keep changes when closing documents
Close windows when quitting an app
When selected, open documents and windows will not be restored when you re-open an app.
Recent items: 10 Documents, Apps, and Servers
Allow Handoff between this Mac and your iCloud devices
Use LCD font smoothing when available

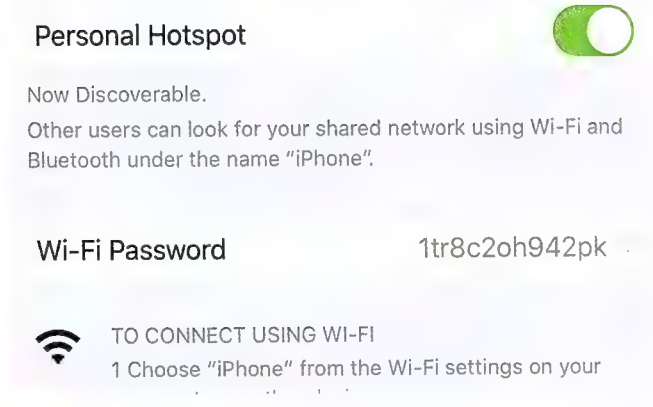
3 SET UP HANDOFF

To use Handoff, a Mac's Wi-Fi must be turned on, even if it's using Ethernet for networking. On your Mac, go to > System Prefs > General and turn on 'Allow Handoff between this Mac and your iCloud devices'.



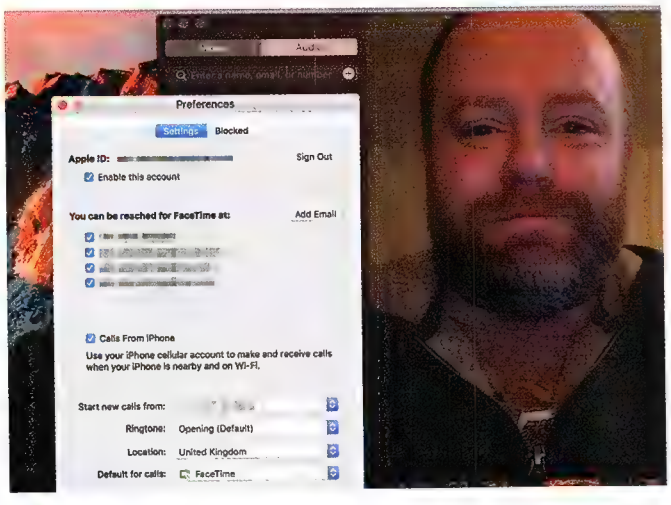
4 SWITCH DEVICES

Enable it on iOS in Settings > General > Handoff. To move a task from iOS to Mac, click the Dock icon left of Finder's. The other way, swipe up from the app icon on the Lock screen, or double-click Home and tap bottom tab.


Personal Hotspot
Now Discoverable.
Other users can look for your shared network using Wi-Fi and Bluetooth under the name "iPhone".
Wi-Fi Password
1tr8c2oh942pk
TO CONNECT USING WI-FI
1 Choose "iPhone" from the Wi-Fi settings on your

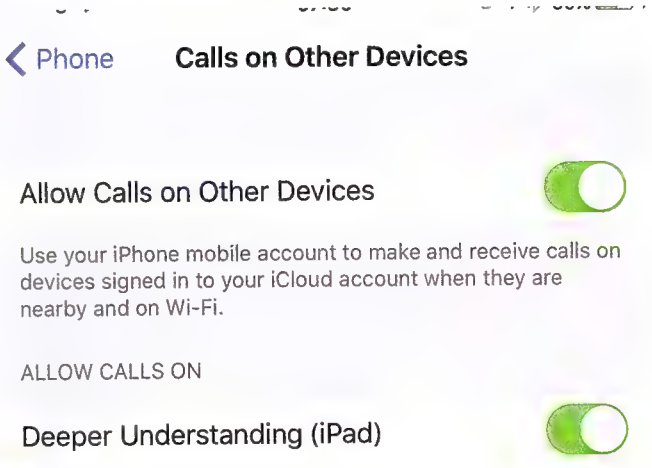
5 SET UP INSTANT HOTSPOT

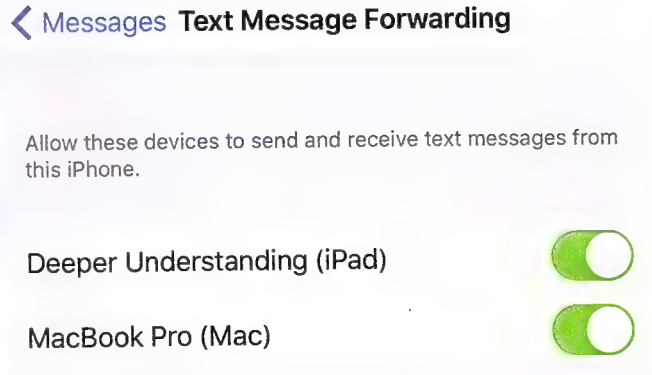
On your iPhone, go to Settings > Mobile Data and turn on the Personal Hotspot feature. From the Wi-Fi icon on your Mac, choose the name of your iPhone. On another iOS device, tap your iPhone's name in Settings > Wi-Fi.



6 PHONE CALLS ON DEVICES

Sign in to FaceTime on each device using the Apple ID you use for iCloud. Ensure your iPhone/devices are on the same network. In Settings > Phone > Calls on Other Devices on the iPhone, enable the 'Allow Calls on...' setting.


Phone
Calls on Other Devices
Allow Calls on Other Devices
Use your iPhone mobile account to make and receive calls on devices signed in to your iCloud account when they are nearby and on Wi-Fi.
ALLOW CALLS ON
Deeper Understanding (iPad)


Messages
Text Message Forwarding
Allow these devices to send and receive text messages from this iPhone.
Deeper Understanding (iPad)
MacBook Pro (Mac)

7 CHOOSE DEVICES FOR CALLS

Pick devices on which to make and receive calls. Turn on 'Calls From iPhone' in FaceTime's prefs on your Mac, and in Settings > FaceTime on iOS. Incoming calls show as a notification on a Mac and a call screen on iOS.

8 SMS AND MMS

Your iMessage account in Messages' prefs (Mac) and Apple ID in Settings > Messages > Send & Receive (iOS) must match. In iPhone's Settings > Messages > Text Message Forwarding, enable devices; enter the code they receive.

Analyse network traffic in Linux

Mihalis Tsoukalos teaches you how to get packet sniffing. Learn how to set up, process and inspect your network traffic using Wireshark and tshark.

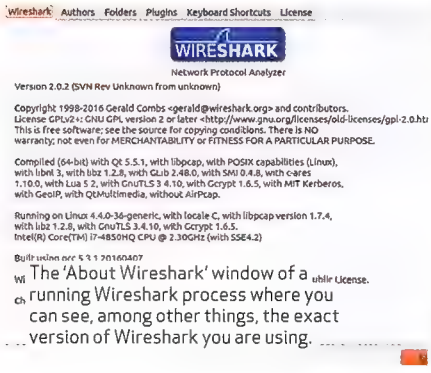
Wireshark, as well as tshark which is the command-line version of Wireshark, are the best tools for analysing network traffic of almost any kind. This tutorial will show you how to use tshark, including using it with Perl and Python, cover its Flow Graph feature and traffic statistics. We'll also present a real scenario that involves the DHCP protocol and how to solve it using Wireshark. If you don't have Wireshark and tshark already installed, you can install both of them on Ubuntu as follows:

```
$ sudo apt-get install wireshark-dev wireshark-qt tshark
```

At the time of writing, the latest stable release of Wireshark is 2.2.0, which can be downloaded from **www.wireshark.org/download.html** (pictured, below, is the About window of Wireshark running on Ubuntu.)

Wireshark has a very handy feature called flow graph, which makes your life easier by visualising and commenting on the network traffic. To use this feature go to the Statistics menu and select the 'Flow Graph' option. See the flow graph in action (opposite, top). As you can see, it can be very handy for getting a high-level overview of your network traffic.

Wireshark can display various types of statistics about the captured data, which can help you get a sense of your data without having to look at every single network packet. This can help you understand whether you've captured the type of network traffic you wanted. In other words, if you want to examine the traffic from a web server but you have too much data, then you need to figure out what went wrong and start capturing again.


Wireshark
Authors
Folders
Plugins
Keyboard Shortcuts
License
WIRESHARK
Network Protocol Analyzer
Version 2.0.2 (SVN Rev Unknown from unknown)
Copyright 1998-2016 Gerald Combs <gerald@wireshark.org> and contributors.
License GPLv2+: GNU GPL, version 2 or later <http://www.gnu.org/licenses/old-licenses/gpl-2.0.ht
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
Compiled (64-bit) with Qt 5.5.1, with libpcap, with POSIX capabilities (Linux),
with libnl 3, with bz2 1.2.8, with GLib 2.48.0, with SMI 0.4.8, with c-ares
1.10.0, with Lua 5.2, with GnuTLS 3.4.10, with Gcrypt 1.6.5, with MIT Kerberos,
with GeoIP, with QtMultimedia, without AirPcap.
Running on Linux 4.4.0-36-generic, with locale C, with libpcap version 1.7.4,
with libz 1.2.8, with GnuTLS 3.4.10, with Gcrypt 1.6.5.
Intel(R) Core(TM) i7-4850HQ CPU @ 2.30GHz (with SSE4.2)
Built using gcc 5.3.1 20160407
The 'About Wireshark' window of a running Wireshark process where you can see, among other things, the exact version of Wireshark you are using.

The bottom-right image opposite is the Statistics menu, plus a window with statistics about the IPv6 protocol. As you can see, there was not so much IPv6 traffic in the captured data.

A PYTHON MODULE FOR TSHARK

This section will briefly illustrate the use of Python 3 module pyshark from the Python 3 shell. The following command will install pyshark: `$ sudo pip3 install pyshark` . First, you will have to execute the Python 3 binary to enter the shell and then execute the following Python 3 code:

```
>>> import pyshark
>>> myData = pyshark.FileCapture('dhcpNormal.pcap', only_summaries=True)
>>> print(len([packet for packet in myData]))
131
>>> numberOfPackets = len([packet for packet in myData])
>>> for i in range(0, numberOfPackets):
    print(myData[i])
```

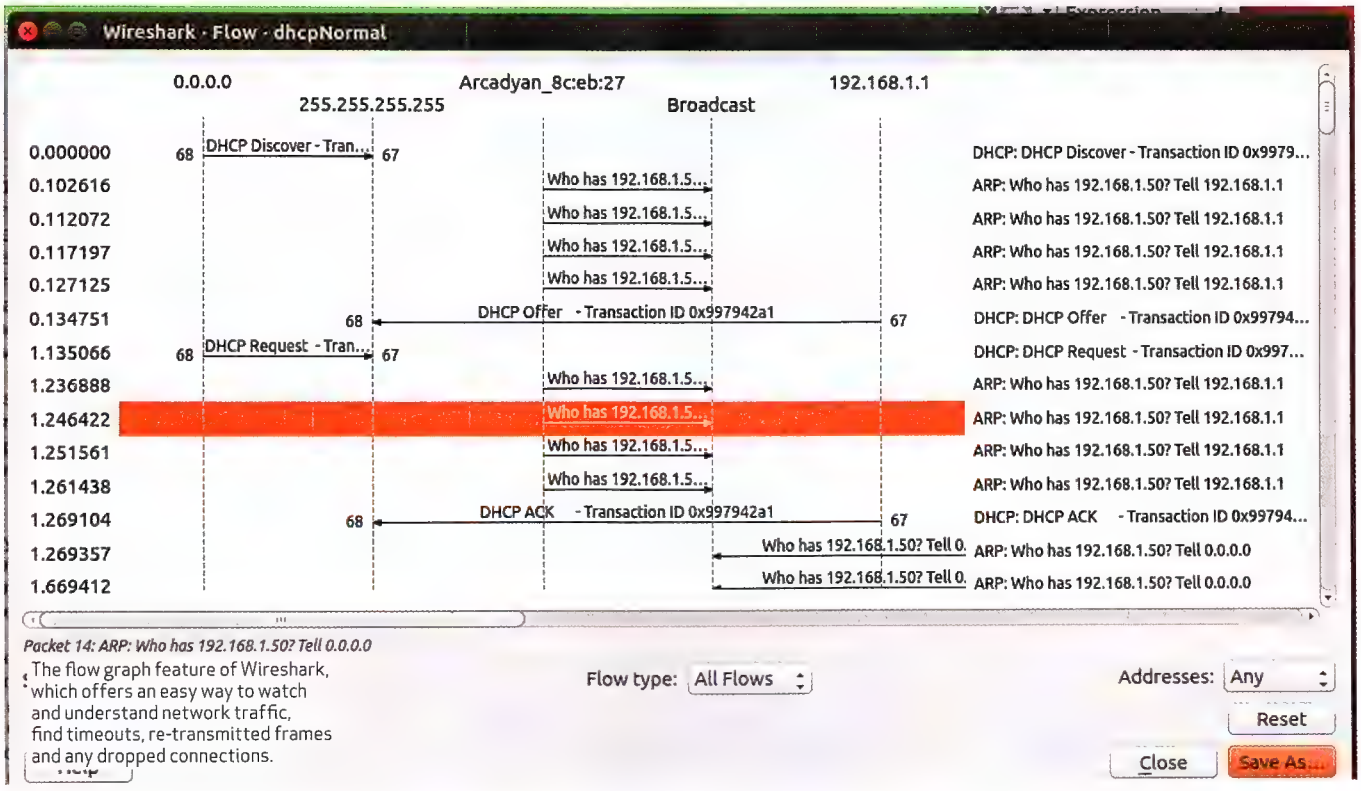
The first command imports the pyshark module and enables you to use it in your session. The second command reads an existing file with network data named 'dhcpNormal.pcap' and saves the output into a variable named `myData` . The third command allows you to find out the number of packets in the file you read and the last part shows how to iterate over all the packets. The pyshark module can do many more things including capturing network data and applying filters – you can find more information about it at **pypi.python.org/pypi/pyshark/0.1**.

SOLVING A REAL NETWORK PROBLEM

This section will talk about a real-case scenario that took place on a company LAN and involves the DHCP protocol. Although the case is real, the presented network data is from another network, which was used for simulating the original scenario in order to protect the privacy of the company.

Additionally, despite the fact that the original network data was examined using Wireshark, this section will mainly use tshark in order to be able to provide the text output.

Before continuing with the solution, it's time to learn about the network problem: some computers on a LAN couldn't connect to the LAN, although other computers were able to without issue. As if this wasn't strange enough, after a given time of the day, which was different each day, no computer could correctly connect to the LAN. Plus, after that time, if a working computer was rebooted, it couldn't connect to the LAN again! The problem somehow depended on the time of the day.


Wireshark · Flow · dhcpNormal
0.0.0.0
255.255.255.255
Arcadyan_8c:eb:27
Broadcast
192.168.1.1
0.000000 68 DHCP Discover - Tran... 67 DHCP: DHCP Discover - Transaction ID 0x9979...
0.102616 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
0.112072 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
0.117197 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
0.127125 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
0.134751 68 DHCP Offer - Transaction ID 0x997942a1 67 DHCP: DHCP Offer - Transaction ID 0x99794...
1.135066 68 DHCP Request - Tran... 67 DHCP: DHCP Request - Transaction ID 0x997...
1.236888 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
1.246422 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
1.251561 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
1.261438 Who has 192.168.1.5... ARP: Who has 192.168.1.50? Tell 192.168.1.1
1.269104 68 DHCP ACK - Transaction ID 0x997942a1 67 DHCP: DHCP ACK - Transaction ID 0x99794...
1.269357 Who has 192.168.1.50? Tell 0. ARP: Who has 192.168.1.50? Tell 0.0.0.0
1.669412 Who has 192.168.1.50? Tell 0. ARP: Who has 192.168.1.50? Tell 0.0.0.0
Packet 14: ARP: Who has 192.168.1.50? Tell 0.0.0.0
Flow type: All Flows
Addresses: Any
Reset
Close
Save As...

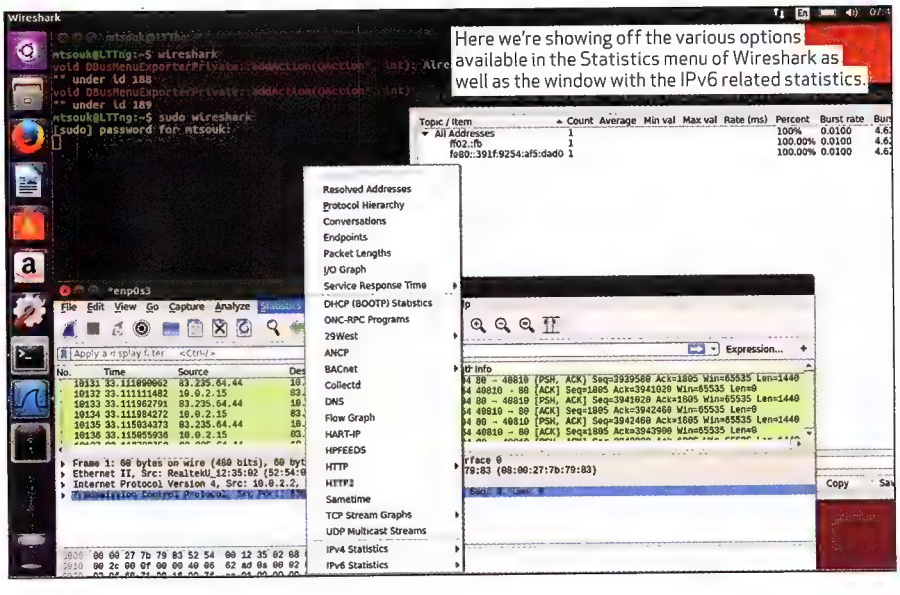
The flow graph feature of Wireshark, which offers an easy way to watch and understand network traffic, find timeouts, re-transmitted frames and any dropped connections.

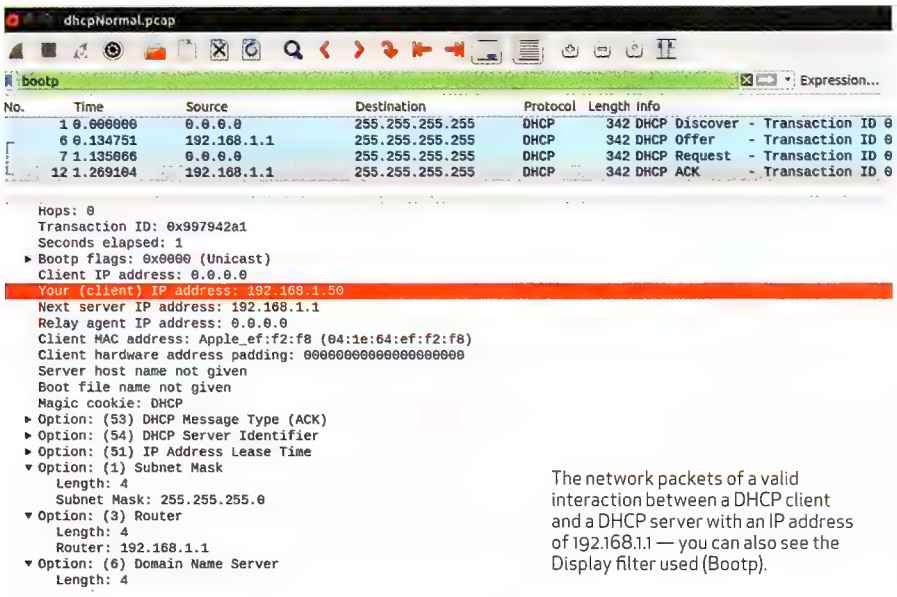
It's easy to imagine that the problem might have been related to the network configuration of the machine and that it might have involved the DHCP protocol because each machine of this particular network gets its network configuration from the DHCP server of the company. As you will see in a while, the problem was indeed DHCP-related. However, sometimes the most improbable things might happen, which means that the root of the problem wasn't clear.

Generally speaking, the nasty problems are the ones that involve a combination of hardware malfunctions and software misconfigurations because hardware problems are usually nondeterministic. Luckily enough, this particular problem only involved a software misconfiguration but in quite a tricky way.

In order to continue, you will need to learn more information about the DHCP protocol. DHCP stands for Dynamic Host Configuration Protocol and provides configuration information to both wired and wireless hosts on TCP/IP networks. The DHCP is based on the BOOTP protocol, which is useful to know because it will allow you to define a proper display filter. Both DHCP and BOOTP use the UDP protocol with port numbers 67 and 68. Usually, a DHCP server provides an IP address, a Subnet mask, one or more DNS servers and a Default gateway to its host, although it is capable of giving many more configuration parameters. The initial communication happens with the help of various basic messages that, for obvious reasons, don't require an IP address. The four messages are DHCPDISCOVER, DHCPOFFER, DHCPREQUEST and DHCPACK. The DHCPDISCOVER message is used by the DHCP client that searches for a DHCP server and is a broadcast message, which means that it's sent to a LAN only using the MAC address of the client, because the client doesn't yet have an IP address. When a DHCP server receives a DHCPDISCOVER message, it replies with a DHCPOFFER message. The DHCPREQUEST message is sent by a DHCP client responding to a DHCPOFFER message from a DHCP server, from a client that wants to verify a previously allocated IP address or from a client that wishes to extend the lease on a network address. Last, the DHCPACK message contains the response of the DHCP server to the DHCPREQUEST message and contains all the necessary configuration information. After a DHCP client receives and processes the DHCPACK message, it's ready to configure its network interface and, therefore, validly connect to the network. All the gory DHCP details are at **www.ietf.org/rfc/rfc2131.txt**.

Two files with network data will be used in this section: the first contains the network data from a normal and proper DHCP transaction and is called 'dhcpNormal.pcap' whereas the file with the DHCP traffic that simulates




dhcpNormal.pcap
bootp
Expression...
No. Time Source Destination Protocol Length Info
1 0.000000 0.0.0.0 255.255.255.255 DHCP 342 DHCP Discover - Transaction ID 0
6 0.134751 192.168.1.1 255.255.255.255 DHCP 342 DHCP Offer - Transaction ID 0
7 1.135666 0.0.0.0 255.255.255.255 DHCP 342 DHCP Request - Transaction ID 0
12 1.269104 192.168.1.1 255.255.255.255 DHCP 342 DHCP ACK - Transaction ID 0
Hops: 0
Transaction ID: 0x997942a1
Seconds elapsed: 1
Bootp flags: 0x0000 (Unicast)
Client IP address: 0.0.0.0
Your (client) IP address: 192.168.1.50
Next server IP address: 192.168.1.1
Relay agent IP address: 0.0.0.0
Client MAC address: Apple_ef:f2:f8 (04:1e:64:ef:f2:f8)
Client hardware address padding: 00000000000000000000
Server host name not given
Boot file name not given
Magic cookie: DHCP
Option: (53) DHCP Message Type (ACK)
Option: (54) DHCP Server Identifier
Option: (51) IP Address Lease Time
Option: (1) Subnet Mask
Length: 4
Subnet Mask: 255.255.255.0
Option: (3) Router
Length: 4
Router: 192.168.1.1
Option: (6) Domain Name Server
Length: 4

The network packets of a valid interaction between a DHCP client and a DHCP server with an IP address of 192.168.1.1 — you can also see the Display filter used (Bootp).

the case with the problem is called 'dhcpProblem.pcap'. Both files were captured using Wireshark – we'll take a look at how to capture and save network data using this tool in depth in a future issue of *APC*. See the screenshot, above, of the four messages of a valid DHCP interaction, as well as some of the contents of the DHCPACK message using the data from dhcpNormal.pcap.

TROUBLESHOOT LIKE A NETWORK PRO

It's now time to start examining the problematic network traffic in more detail by looking at the traffic that's related to DHCP. So dhcpProblem.pcap contains the following network packets related to DHCP:

```
$ tshark -r dhcpProblem.pcap
-Y 'bootp'
    1   0.000000       0.0.0.0
-> 255.255.255.255 DHCP 342
DHCP Discover - Transaction ID
0x7cdcacad
    2   0.007067 192.168.1.254
-> 255.255.255.255 DHCP 321
DHCP Offer    - Transaction ID
0x7cdcacad
    3   0.008310       0.0.0.0
-> 255.255.255.255 DHCP 353
DHCP Request  - Transaction ID
0x7cdcacad
    4   0.015050 192.168.1.254
-> 255.255.255.255 DHCP 321
DHCP ACK      - Transaction ID
0x7cdcacad
    5   0.910851   10.0.10.10
-> 255.255.255.255 DHCP 348
DHCP Offer    - Transaction ID
0x7cdcacad
    6   0.912131   10.0.10.10
-> 255.255.255.255 DHCP 348
DHCP Offer    - Transaction ID
0x7cdcacad
```

As you can see, there are more network packets than expected. What's stranger is the presence of two DHCPOFFER packets, which means that you might have two DHCP servers on the network instead of just one! The IP addresses of the two DHCP servers, according to the two DHCPOFFER messages, are 192.168.1.254 and 10.0.10.10. As you already know that the IP address of the legitimate DHCP server is 10.0.10.10, the presence of a second DHCP server with an IP address of 192.168.1.254 might be the root of the problem. On the left-hand side of the `->` sign of each packet is the IP address of the sender, whereas on the right-hand side is the IP address of the destination computer. As the DHCP client doesn't have an IP address when it sends the DHCPDISCOVER and DHCPREQUEST messages, the source IP address of packets with numbers 1 and 3 is 0.0.0.0. Similarly, both DHCP servers send a broadcast message to the **255.255.255.255** address, which is received by the DHCP client.

In order to look into a specific network packet from the previous interaction, you should use tshark as follows:

```
$ tshark -V -r dhcpProblem.
pcap -Y frame.number==1
```

You know that your machine is using the non-legitimate DHCP server because you've received a DHCPACK packet from it! So you want to look into frame number 4 because the DHCPACK message contains the information for the network configuration of a DHCP client:

```
$ tshark -V -r dhcpProblem.
pcap -Y frame.number==4
```

As the previous output – which is not shown on the screen – is relatively big, you can try the following two variations of the command:

```
$ tshark -V -r dhcpProblem.
pcap -Y frame.number==4 | grep
"IP address"
```

Wireshark vs tshark

Although Wireshark is a great and powerful application to use, there are times that you need something lighter for your work, and something that can execute remotely without a graphical user interface. In such situations, you can use tshark. The following Perl script, for example, shows how to use tshark to automate things:

```
#!/usr/bin/perl -w

use strict;
my $TSHARK_BINARY = "/usr/local/bin/
tshark";
my $filename = shift @ARGV || "filename";
my $command = "$TSHARK_BINARY -r
$filename";
my @netDATA = `$command`;
my $totalLines = 0;
foreach my $line (@netDATA) {
 $totalLines++;
}

print "Number of lines read:
$totalLines\n";
exit 0;
```

If you attempted to do the same thing using the graphical interface of Wireshark, it would take more time and system resources and cannot be executed as a cron job.

Additionally, you can easily process the output of tshark using traditional Unix command line tools, such as grep, AWK, sed and so on. Nevertheless, when you want to look closely at the contents of lots of network packets, using Wireshark instead of tshark is almost mandatory because the graphical interface makes your life a lot easier.

```
    Client IP address:
0.0.0.0
    Your (client) IP address:
192.168.1.68
    Next server IP address:
0.0.0.0
    Relay agent IP address:
192.168.1.254
```

Or alternatively:

```
$ tshark -V -r dhcpProblem.
pcap -Y frame.number==4 | grep
"DHCP Server"
    Option: (54) DHCP Server
Identifier
        DHCP Server
Identifier: 192.168.1.254
```

The previous output verifies our suspicions: the DHCP client uses another DHCP server to configure its network interface, so instead of getting an IP address that belongs to the 10.0.10.x network, it gets the 192.168.1.68 IP address, which is why it can't communicate with the internet and the other machines on the LAN.

CASE STUDY

Back to the real situation now: after finding out that there was a second DHCP server running, the execution of some commands on a Cisco switch revealed the switch port of the physical computer and, therefore, the machine itself. The actual root of the problem was that this machine was running a virtual machine with Linux, which was running its own DHCP server! As this machine was turned off during non-working hours, the problem was occurring when the user of the machine was turning on their computer, which explains the fact that some computers were being configured from the legitimate DHCP server!

After that, an email was sent to every user, advising them to avoid running unnecessary services on their Linux machines!

```
2. mtsouk@mail: ~/docs/article/working/WireShark.LXF218/code (ssh)
  2   0.007067 192.168.1.254 -> 255.255.255.255 DHCP 321 DHCP Offer    - Transaction I
D 0x7cdcacad
  3   0.008310       0.0.0.0 -> 255.255.255.255 DHCP 353 DHCP Request  - Transaction ID
 0x7cdcacad
  4   0.015050 192.168.1.254 -> 255.255.255.255 DHCP 321 DHCP ACK      - Transaction I
D 0x7cdcacad
  5   0.910851   10.0.10.10 -> 255.255.255.255 DHCP 348 DHCP Offer    - Transaction ID
 0x7cdcacad
  6   0.912131   10.0.10.10 -> 255.255.255.255 DHCP 348 DHCP Offer    - Transaction ID
 0x7cdcacad
code$ tshark -r dhcpProblem.pcap -Y 'BOOTP'
tshark: "BOOTP" is neither a field nor a protocol name.
code$ tshark -r dhcpProblem.pcap -Y 'bootp'
  1   0.000000       0.0.0.0 -> 255.255.255.255 DHCP 342 DHCP Discover - Transaction ID
 0x7cdcacad
  2   0.007067 192.168.1.254 -> 255.255.255.255 DHCP 321 DHCP Offer    - Transaction I
D 0x7cdcacad
  3   0.008310       0.0.0.0 -> 255.255.255.255 DHCP 353 DHCP Request  - Transaction ID
 0x7cdcacad
  4   0.015050 192.168.1.254 -> 255.255.255.255 DHCP 321 DHCP ACK      - Transaction I
D 0x7cdcacad
  5   0.910851   10.0.10.10 -> 255.255.255.255 DHCP 348 DHCP Offer    - Transaction ID
 0x7cdcacad
  6   0.912131   10.0.10.10 -> 255.255.255.255 DHCP 348 DHCP Offer    - Transaction ID
 0x7cdcacad
code$ tshark -r ~/nmap.pcap -c 5 -Y frame.number\>=1
  1 0.000000000 82.98.136.22 -> 109.74.193.253 DNS 108 Standard query 0x60c4  A 219.76
.15.185.bl.spameatingmonkey.net
  2 0.000066000 109.74.193.253 -> 82.98.136.22 ICMP 136 Destination unreachable (Port
unreachable)
  3 0.[illegible]80.89.132.142 -> 109.74.193.253 DNS 86 Standard query 0x11cc  A Ns3.ur
mc
  4 0.[illegible]00.13.241.218 -> 109.74.193.253 DNS 86 Standard query 0x6f53  AAAA ns
1.
  5 0.[illegible]109.74.193.253 -> 200.13.241.218 ICMP 114 Destination unreachable (Por
t unreachable)
```

This is the output and the generated files from various executions of the tshark command

Please note that, in case you want to use Wireshark instead of tshark, you can use the same Display filter in Wireshark. You will just see the same output in a different format because of the graphical interface of Wireshark. In other words, nothing that you learn for tshark is wasted when used in Wireshark and vice versa! Although it wasn't needed in this situation, MAC addresses are truly useful when you want to track a given machine that resides on your LAN, because the IP of a device can change but its MAC address will not change so easily. In other words, use a Display filter that tracks the network traffic from and to the MAC address of the desired machine.

As you can appreciate, in order to solve a network-related problem with Wireshark, you will need a pretty good knowledge of networking, which, in this case, covers the way DHCP works, but you will also need to know how to interpret the network data correctly because the theoretical isn't enough to reveal the actual problem.

More about tshark

We often say that using a command-line utility is generally the best tool for getting information about your Linux system and tshark is no exception in that regard. The following tshark command lists the available network interfaces: `$ tshark -D` . The `-w` parameter followed by a filename will store the captured data into a file with the given filename, whereas if you use the `-c` parameter, it allows you to specify the number of packets you want to capture. The `-r` parameter followed by an existing filename will allow you to replay a previously captured data file on your screen.

You can also specify Display filters with the help of the `-Y` option followed by the actual filter you want to use in quotes, for example:

```
$ tshark -r dhcpProblem.pcap -Y 'bootp'
```

Should you wish to display the contents of a specific network packet in ASCII format, you can use the following command, which displays packet number 5:

```
$ tshark -V -r dhcpProblem.pcap -Y frame.
number==5
```

If you want to display more than one packet, you can use tshark with the `-c` option, which allows you to specify the maximum number of packets you will read:

```
$ tshark -r ~/nmap.pcap -x -c 5 -Y frame.
number\>=1
```

The previous example will read five packets and display them because it starts with packet number 1. So if dhcpProblem.pcap contains six packets only, you will need to execute the following command to display the last two network packets:

```
$ tshark -r dhcpProblem.pcap -x -c 6 -Y
frame.number\>=5
```

See the screenshot, above, that shows the output from various executions of tshark based on the presented information.

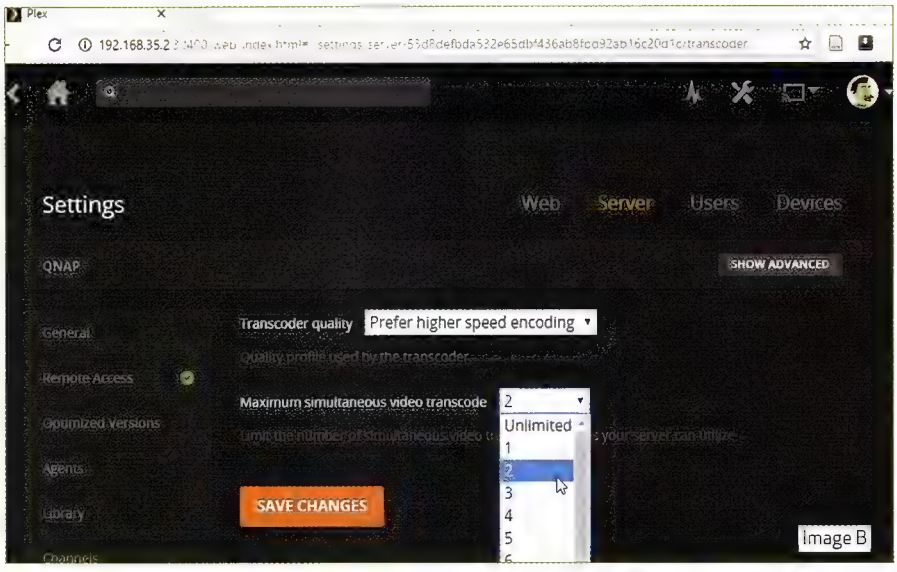
Create a Plex-powered media server

The APC team explains how rapidly set up a personal media server.

If you're looking for a media server that doesn't just enable you to organise and play your media, but shows it off in the best possible way, you need Plex. It works across just about any device you own, and enables you to watch across multiple platforms, both at home and over the internet, picking up where you left off watching on another device.

The biggest issue with Plex is choosing the server to run it on. A PC is an obvious choice, but it needs to be left on 24/7 for unlimited access. You're better off installing it on a dedicated low-power device, such as a high-end NAS, like QNAP's TS-251+, which boasts a quad-core Celeron CPU and hardware transcoding engine. But that's not necessarily affordable, so a cheaper NAS with app support (like the WD My Cloud – **Image A**) or a Raspberry Pi 2 or 3 is capable of serving media.

The major trade-off is performance – you free up resources from your main PC, but your server is slower and visibly less responsive. It still does the job, though, and armed with the following tips, you'll squeeze that bit more performance from it to deliver a great media experience.



1 USE THE RIGHT FORMAT

The most effective way to improve performance is by reducing – or even eliminating – transcoding. Transcoding converts your media stream from its native format to one that's compatible with your media-playing device, so the more exotic and varied your media formats are, the more likely it is that Plex needs to transcode them.

Wherever possible, save your media in MP4 file containers using the H.264 video and AAC or MP3 audio codecs – this is the closest to a universal format you can get, and most devices should be able to play it directly. Handbrake **(www.handbrake.fr)** can do this for you.

The critical elements here are the codecs – if you use a different file container (such as MKV or AVI) with H.264 and AAC/MP3, Plex uses a process called Direct Stream to "remux" the file in a compatible container (typically MP4) before streaming it. Although this requires extra processing power, remuxing is far less demanding than a full transcode.

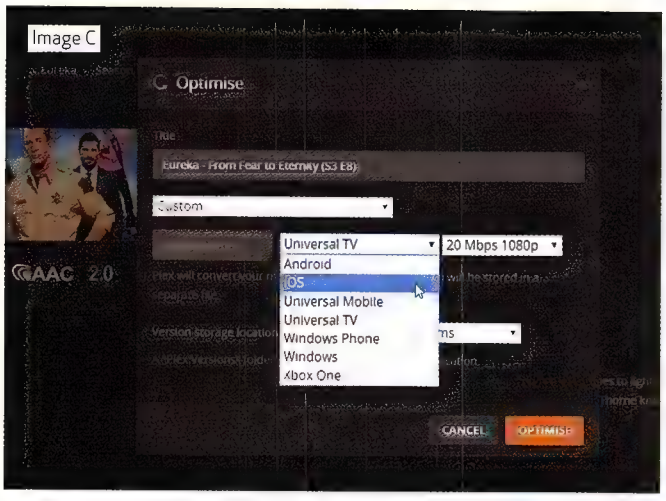
2 ADD SUBTITLES

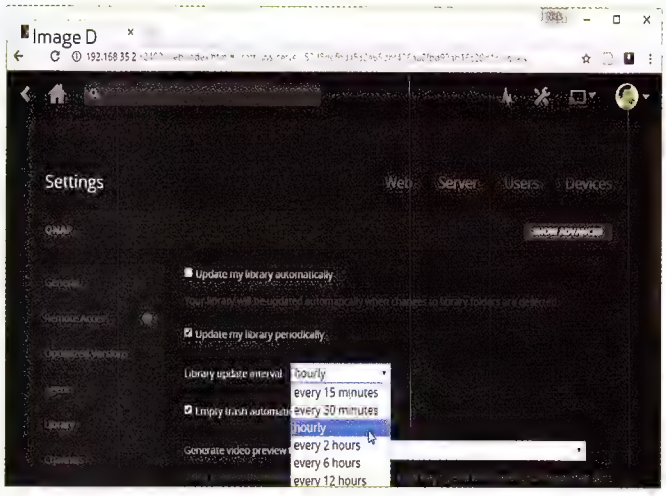
If you need subtitles, it's important to choose the right format if you use external files – otherwise Plex has to transcode the stream to accommodate them. Go to 'Media Preparation › Subtitles' at **support.plex.tv/hc/en-us** for instructions. Here, you'll discover which formats to choose to avoid transcoding (SRT and VTT are two), along with a means of fetching subtitles on demand from the Internet using **OpenSubtitles.org**. Then browse to 'Settings › Languages', check the 'Automatically select' box, and set Subtitle Mode to 'Shown with foreign audio' and 'Prefer subtitles in' to 'English', if that's what you're after.

Subtitles are notorious for being out of sync – if your media player doesn't provide offset controls (typically in milliseconds), visit **www.subsedit.com/simple** to paste in your subtitles from a text editor, select an offset, and generate a new SRT file that syncs perfectly. Use VLC Media Player's 'Tools › Track Synchronization' with the original SRT file to calculate the offset you need.

3 SPEED UP NETWORK CONNECTIONS

If you connect your server wirelessly





to your network, you can improve its performance by taking it off your congested Wi-Fi network, and connecting it via Ethernet cable — either directly to your router or indirectly via a switch or HomePlug network (500Mb/s is adequate, but 1,300Mb/s is best if your server frequently serves multiple streams).

Some NAS drives — including our beloved QNAP — offer dual Ethernet ports with support for Link Aggregation Control Protocol (802.3ad). Pair this with a suitable network switch (such as TP-Link's affordable TL-SG2008 model), and you'll boost network throughput when serving multiple connections.

4 TRANSCODER SETTINGS

There's a noticeable lag when playing back media over the internet — like it or not, this involves some transcoding, even with directly supported formats. To boost responsiveness at the expense of quality, log on to your server through your web browser: '192.168.x.y:32400/web', where '192.168.x.y' is the IP address of the device running your server. Choose 'Settings > Transcoder', and set 'Transcoder quality' to 'Prefer higher speed encoding'.

Plex is also set to transcode an unlimited number of streams — restrict this to just one or two via the 'Maximum simultaneous video transcode' drop-down — **Image B.** Note: This doesn't restrict Direct Play connections.

5 OPTIMISE FOR TRANSPORT

Does Plex struggle to deliver a good stream to certain devices? You can use its Media Optimizer tool to make use of idle server time, by converting selected media files to a format that will stream using Direct Play, without buffering or dropping frames.

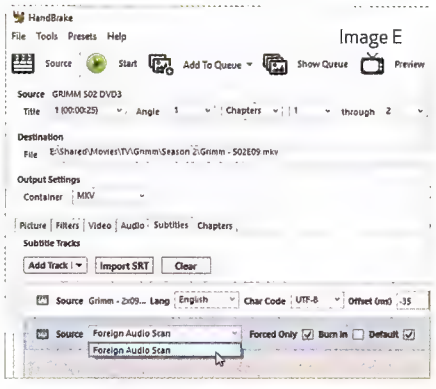
The process produces a smaller, lower-quality copy of the file in question, which sits alongside the original, and improves streaming performance.

Don't optimise your entire library; instead, optimise on demand — maybe you're going away for a few days, and want access to three or four TV episodes or movies. To do this, log into the server in your web browser, then browse to the movie or episode in question. Click the '...' button in the left-hand pane, and choose 'Optimize'. Pick a preset: Mobile, TV, Original or Custom (this latter option lets you choose from more presets, or set your own frame rate and resolution). Leave the default storage location alone, and click 'Optimize' — **Image C.**

6 TWEAK OPTIMISATION SETTINGS

Media is optimised one file at a time, but you can build a queue. Check their progress via the Conversion tab. To manage optimised versions — allowing you to delete some or all of these converted files to reclaim drive space at a later date — go to 'Settings > Optimized Versions'.

Return to 'Settings > Transcoder' and click 'Show Advanced'. At the bottom of the screen, you'll see the 'Background transcoding x264 preset' setting — it's set to 'Very fast' by default, but consider 'Super fast' or even 'Ultra fast', if the optimisation process is taking too long, and you're not bothered by video quality.



7 RESTRICT LIBRARY UPDATES

Go to 'Settings > Library' to manage how Plex updates your media libraries. By default, it monitors for new and changed content in your media folders, then updates accordingly. This isn't practical on lower-end media servers, such as the Raspberry Pi, so restrict the scan to no more than once an hour using the 'Update my library periodically' option instead. Also consider setting 'Generate video preview thumbnails' and 'Generate chapter thumbnails' to 'Never' to reclaim more system resources — **Image D.**

Embed subtitles

An alternative way to access subtitles is to embed them into your media using Handbrake. A full guide can be found under Advanced Features at **handbrake.fr/docs/en** — but it's basically this: load up your media, switch to the Subtitles tab and either import your SRT file (you can set an offset if required), or click Add Track if ripping from DVD. Look for a 'Foreign Audio Scan' option — **Image E,** which attempts to detect the foreign-language dialog track for you, then check both 'Forced Only' and 'Default' (or 'Burn In' if you want the subtitles to be physically overlaid on the video track, which means they're visible even if subtitles are switched off). You'll never be bamboozled by Jabba the Hutt again.

The ultimate PC upgrade

Is this slightly extreme build necessary? Absolutely not. But does it look good? Damn right it does, says Zak Storey.

THE CONCEPT

Winter is here, the cold dark nights have firmly fixed themselves upon us, and as the bitter chill of the north wind bites into the flesh in those dark and sombre hours, it's important to have something to comfort the soul, as we come out of the snow (if we're lucky) and into the warmth.

"Something?" Well, this is *APC*, so it has to be a system. In short, the aim of this is to be the ultimate upgrade. After a year of fantastic releases and phenomenal performance increases, our reviews editor decided it was about time he pursued an upgrade of his own. What are we upgrading from? Well, at the heart of the system was an Intel Core i7-6700K @ 4.8GHz, 32GB of Kingston HyperX DDR4 @ 2,400MT/s, an Nvidia GeForce GTX 1070, one Samsung 950 Pro 256GB M.2 SSD and a 1TB OCZ Trion 100 SSD.

There are a few other details – the Corsair Hydro H100i GT cooling the CPU is kept chilled by four Noctua NF-F12 iPPC fans, and the power is supplied via a Corsair AX1200i inside an NZXT Manta chassis.

It's a respectable rig. Already quite the powerhouse of technology, but not without its flaws. The fans are too loud, they spin at too high an RPM; the GPU, although powerful, isn't enough to satisfyingly gaming at 4K; and the ASUS Z170i Pro Gaming is having trouble booting from that Samsung PCIe SSD, with load times reaching into minutes in some cases.

The solution to all these woes came from two desires. One, to swap out from a 28-inch TN 4K Iiyama Prolite B2888UHSU (seriously, who thought of that designation?) to a 27-inch IPS 165Hz 1440p AOC Agon AG271QG. And the second to utilise the absolutely stunning NZXT Source 340 Elite chassis.

GLUTTONY AND HARDWARE DECISIONS

For this build, it was all about keeping it as clean as possible; accenting just the hardware, and drawing away from the cables and anything else cluttering up the interior. To start, we opted for the ASUS Z170 TUF Sabertooth motherboard, with a twist. The thermal armour covering the majority of the mobo helps keep it looking slick, but the mid cap, with its chrome finish, is a bit gaudy, so that would have to be plastidipped. Then it was on to the cooling. As the NZXT Kraken X52 had just arrived in the office, it seemed like the obvious choice. For fans, we opted for three of Corsair's ML120 Pros with white LEDs; their super-low RPMs mean they can run whisper quiet, and they look awesome. We had them in a pull configuration on the radiator, purely to ensure we could see some form of movement inside the case itself.

For graphics, we went with two MSI GeForce GTX 1080 Gaming Xs, and with one of MSI's HB bridges as well, to give them a little more pizazz, and to put to bed the question of whether or not the HB bridge makes a difference. Memory was provided by four sticks of 16GB G.Skill Trident Z DDR4, and the storage changes came in the form of swapping out the 256GB 950 Pro to a 250GB 960 Evo, and the 1TB OCZ Trion 100 for the now slightly ageing 2TB Samsung 850 Pro 2.5-inch SSD instead.

PARTS LIST

PART		STREET PRICE
CASE	NZXT S340 ELITE	$149
MOTHERBOARD	ASUS Z170 TUF SABERTOOTH MK1	$429
CPU	INTEL CORE I7-6700K	$489
MEMORY	G.SKILL TRIDENT Z 64GB (4 X 16GB) @ 3,200MT/S	$636
GPU	2 x MSI GEFORCE GTX 1080 GAMING X	$2,058
PSU	CORSAIR HX1000I	$299
STORAGE 1	250GB SAMSUNG 960 EVO M.2	$189
STORAGE 2	2TB SAMSUNG 850 PRO	$1,225
COOLING	NZXT KRAKEN X52, 3 X CORSAIR ML120 PRO WHITE	$318
ACCESSORIES	2 X BITFENIX ALCHEMY LED STRIPS, 2 X SILVERSTONE DUST FILTERS, BITFENIX ALCHEMY CABLE KIT, MSI HB BRIDGE	$229
TOTAL		$6,021

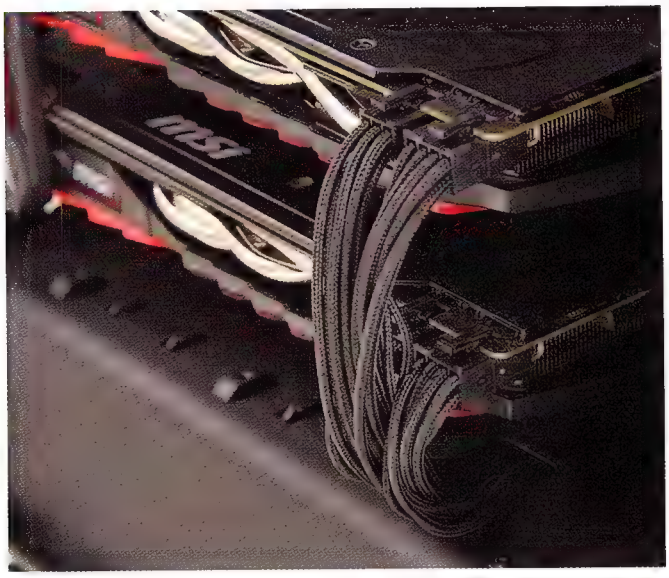
"It was all about keeping it as clean as possible; accenting just the hardware, and drawing away from the cables and anything else cluttering up the interior."

1 ALL THINGS COOLING

It's the small details that matter the most. With limited airflow, we had to be smart about how we installed the setup. By default, the S340 supports up to two 140mm fans in the front, one 140mm fan in the roof and one 120mm fan in the rear. To ensure we had a positive system, the plan was to install the Kraken X52 in the front of the case, using the two ML120 Pros as intakes, and then only have one ML120 Pro exhausting air out of the back, leaving the top fan empty. The only problem being the excessively open grille letting in dust. To counter this, we opted to grab two Silverstone magnetic dust filters, one for the rear of the chassis and one for the roof. These set us back about $16 each, but are well worth it in the long run.

2 SLI BRIDGES AND YOU

The next addition to this build was the SLI bridge. Now, we're still not entirely convinced about how much this actually affects performance, but judging by the fact that the Fire Strike scores are slightly higher at 1440p and 4K, we assume it's doing something worthwhile. That said, what it definitely does add is a bit of bling, along with additional support between the two cards, reducing GPU sag in return. The LED lighting, although not controllable, does look pretty swish with the GTX 1080s, and the brushed aluminium finish fits in nicely with our overall aesthetic.



3 CABLING AND CASE MANAGEMENT

For cabling, we decided to opt for a set of pre-sleeved cables from BitFenix. In fact, we were pretty shocked to discover they sold full kits, but with support for a variety of brands, including EVGA, Corsair, Seasonic, Be Quiet! and Cooler Master, it was a no-brainer. The original intention was to pop out the ATX pins and fit them with E22 stealth combs, to further smarten them up, but, unfortunately, they turned out to be too tight to remove from the factory fitting — a tutorial for another time, perhaps. On top of that, the S340 Elite comes with fantastic cable routing options, with the SATA SSD mount in the floor (if you're not running two HDDs behind the PSU cover), the GPU power passthrough and, of course, the giant cable bar running up through the centre of the chassis.

4 SSD DECISIONS

2.5-inch SSD support in the S340 Elite is an interesting proposition. You have three options for placement. You can place one at the front, on the side of the PSU cover, two below the graphics cards, with easy cutout holes for cables to reach through, or two in the hard drive cage, inside the PSU cover. Because we opted to use a 250GB Samsung 960 Evo M.2 drive for our OS, hidden away under our motherboard's armour, we decided on a single SSD on the PSU cover, and removed the additional two SSD sleds below the GPUs, to make it look a little cleaner. We were fortunate with this build in that the two MSI cards, spaced so far apart, successfully cover those two sleds; without them, two empty bays would look a little out of place.

5 TAMING THE KRAKEN

What a beautiful piece of craftsmanship — NZXT's latest AIOs look stunning. The infinity mirror on the CPU block is nothing short of awe-inspiring, but to run a block like that, in this manner, requires a plethora of cables, including a substantial micro-USB cable, and a proprietary fan/pump cable. These were a little difficult to route. We ended up running the micro-USB through the CPU power cutout, and the rest of the cables into the back of the chassis, to the top-right of the motherboard, before routing them back through to reduce cable slack. The pump header was then carefully weaved around the thermal armour and into the fan header, below the four sticks of DDR4.

6 LIGHTING PERFECTION

Lighting in this build is tricky. We're still not 100% sure whether this will be the final configuration, but it does look cool. The general rule of thumb for lighting anything is that the lights themselves shouldn't be seen, but the light they throw should. You can work different angles and highlight different products by utilising either LED strips or individual LEDs. One thing to note: You should almost always use white LEDs; using any other colour LED strips pulls all the colour out of your components, and just bathes them in the color of the lights. Also, you need to be smart with your strip purchases. We use magnetic BitFenix Alchemy 2.0 strips in our steel chassis builds, and normal adhesive-based ones in acrylic or aluminium cases.

1 There are two cutouts here for SSD cables; we chose to use the one closest to the front panel, as it meant we could keep our SSD branding the right way up, and the cables out of sight. Unfortunately, it does limit the potential of those two 3.5-inch bays behind.

2 We originally intended to do a bit of a minor mod here, by taking a pre-braided cable kit, popping off the connectors, and fitting them with stealth combs to keep them better aligned. However, they proved to be too difficult to remove, so we opted to run without. A how-to feature coming up soon, most likely.

3 The plastidip job we did on the ugly chrome motherboard cover really did the trick. Thanks to the plastic paint covering it, it matches the rest of the build, doesn't look too gaudy and is easily removable if necessary in the future.

4 The Kraken X52 is certainly a treat to look at. That said, there's something about a 240mm radiator that doesn't sit right with us nowadays. Especially because there are so many well-developed 140mm static pressure fans available, mag levs included.

"Why not make the most of it and take the opportunity to make your system beautiful?"

The perfect, easy-build, aesthetic PC

We set out to prove that you don't have to go the whole hog to create a stunning-looking system. Things such as liquid-cooling, although coming with their own thermal advantages and aesthetics, aren't the be all and end all of bespoke custom PCs.t Yes, the build we have here is monstrous and comes with a hefty price tag, but its components are, in lots of ways, very similar to those at all ends of the spectrum. GPUs with four-figure price tags often use the same cooler designs as those costing just under $200; the highest capacity memory still fits into the same slots as those two 4GB DDR4 sticks; and so on. Although SLI is limited nowadays to only operating on the GTX 1070 and above, you can achieve similar results with AMD solutions, or even just opt for a single, more powerful card.

For some, aesthetics are a waste of time in computing. After all, it's just a box that's going to end up under your desk, so why care? Because it's something you pour time and money into, something you sit at, often for hours, working, enjoying media, gaming, so why not make the most of it, and take the opportunity to make your system beautiful?

Of course, it does cost more to do something like this, but it could be less than you think. Taking time to route your cables and tidy them up costs nothing. The next step up, a new case, an LED strip or two, and a braided cable kit for your PSU, can come in at less than $300. Add in two or three fans and a decent dual-rad cooler for 400–500 bucks, and you net yourself improved thermals, lower noise and a system you can proudly display in your home. That's a win in our books.

But enough justification, what about the system? Well, it looks stunning. The Kraken X52 not only looks good, but also keeps the chip cool, with temperatures ranging from 27°C at idle, up to 52°C under load. Corsair's ML120 Pro fans are extremely quiet, the only downside being that the MSI cards can get noisy under load.

As a performer, it's quite impressive; rendering performance is snappy and having access to 64GB of DDR4 makes for exceptionally fast Photoshop work. We're utilising a 24GB RAM cache to take advantage of all that storage by transferring the browser cache, scratch disk and temporary system files to it to alleviate load times, among other things. Gaming on older titles is nifty, and although there are a few issues with newer AAA games, it's an exceptionally enjoyable experience at 1440p and above, with frame rates reaching well into the 70s and beyond.

Is it perfect? Arguably no. There are still things we can tweak: an extra LED or two, better cable routing and our own custom cables. And, no doubt, the mighty Kaby Lake and a multitude of upgrades lie in its future.

But, for now, this reviews editor couldn't be happier, with a well-rounded system to see us through those harsh winter months. ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI THREAD	987	895 (-9%)
CINEBENCH R15 SINGLE THREAD	196	179 (-9%)
TECHARP'S X264 HD 5.0.1 (FPS)	21.93	19.59 (-11%)
CRYSTALDISK QD32 SEQUENTIAL READ	1,895	2,927 (54%)
CRYSTALDISK QD32 SEQUENTIAL WRITE	949	1,538 (62%)
RISE OF THE TOMB RAIDER (FPS)	76	84 (11%)
FAR CRY PRIMAL (FPS)	72	82 (14%)
THE DIVISION (FPS)	42	134 (219%)

Our APC Labs test PC uses a Core i7-6700K CPU @ 4.6GHz, an AMD R9 Fury X, and 32GB of RAM. All games are tested at 1080p on max settings, with HD texture packages installed.

The ideal finished project. The green LED signifies the device is online, push down the blue LED button to talk.

Build a walkie-talkie with a Raspberry Pi

Nate Drake tickles your nostalgia bone with Daniel Choate's awesome TalkiePi project to create retro-style Wi-Fi walkie-talkies.

Those who have been following the TV series *Stranger Things* may have felt a twinge of nostalgia at the retro walkie-talkies used by the children. New Zealander Daniel Chote decided to take his own homage to the '80s one step further. The TalkiePi turns your Pi into a simple push button walkie-talkie, which works over Wi-Fi.

Chote designed the project with his kids in mind. Once the software is installed, it will automatically connect to his own server using the Mumble protocol allowing users to chat right away. The software on his GitHub page is combined with detailed instructions of components and even a casing design that can be manufactured with a 3D printer to provide a nostalgic experience that will tug at the heartstrings of the average 30-something and upwards.

The interface of the TalkiePi couldn't be more simple. When the button is depressed, it lights up and you can talk. When depressed, the channel is clear. There are two other status LEDs which indicate your connection to the wireless network and if others have joined your particular channel.

This project isn't only useful for children. Many gamers make use of the Mumble protocol to talk while playing. Two TalkiePis can also be used as a handy intercom for your front door.

GETTING STARTED

To begin, you will need a Raspberry Pi with Raspbian installed on the SD card for each TalkiePi you want to build. The Raspberry Pi 3 is perfect for this project as it has integrated Wi-Fi. The microphone originally used in the projects is US Robotics USB Speakerphone (USR9610), removed from its casing and connected to the Pi. This can be hard to obtain outside the US, so either search eBay for the same model or find a substitute. Be careful to choose one which works over a USB cable and not Bluetooth.

To power the Pi, you'll need a short 90-degree USB cable. If you're planning on printing the TalkiePi casing, you'll also need five M3 nylon screws and one M3x20 nylon standoff. You can buy a pack of ten screws and standoffs (plus bonus nuts) from **littlebirdelectronics.com.au** for just $2.93, so grab two. The case will also require two M3 15mm and two M3 25mm bolts. Packs of 25 can be purchased from **www.altronics.com.au** for $4.50 and $7.70, respectively, plus the speaker requires two M3 10mm bolts, which can be picked up for $4.10 for a pack of 25. The speaker itself requires two M3 10mm bolts and nuts. To connect your wiring and LEDs to the Pi, you'll need a GPIO Header connector. Pretty much any header will do. Both the 'status' LEDs should be 5mm, each with its own holder. A five-pack of Adafruit LED holders goes for just $9.09 at **core-electronics.com.au**. It also sells pushbutton LEDs, one of which will be necessary for the 'talk' button. There are some basic light-up plastic buttons available, with more sophisticated metal and waterproof options as well.

The original TalkiePi project was built with a plastic pushbutton but feel free to change this if you feel confident. The TalkiePi also needs three 330-Ohm resistors. These should be readily available at your local

Certified Mumbler

Mumble software, like the TalkiePi program, can use certificates to connect to Mumble servers. This avoids the need for typing in passwords and allows you to register accounts easily with new servers. By default, this feature is switched off in TalkiePi as Daniel Choate's own server, which he set up for his children, doesn't require certificates. If you wish to use other Mumble servers, however, connect to your Raspberry Pi via SSH, then run `su mumble` to switch to the mumble user and `cd ~` to switch to the home directory.

You'll need to generate a container for your certificate with the command:

```
openssl genrsa -aes256 -out key.pem
```

You'll also be asked to enter a password. Next create the certificate itself with:

```
openssl req -new -x509 -key key.pem -out cert.pem -days 1095
```

Enter the same password as before and press return when asked to choose the default options such as location, email address and so on. Next run:

```
openssl rsa -in key.pem -out nopasskey.pem
```

and enter the password one last time. Finally run:

```
cat nopasskey.pem cert.pem > mumble.pem
```

This will combine your files into a single certificate. Run `sudo -i` to switch back to the root user, then use the command:

```
nano etc/systemd/system/mumble.service
```

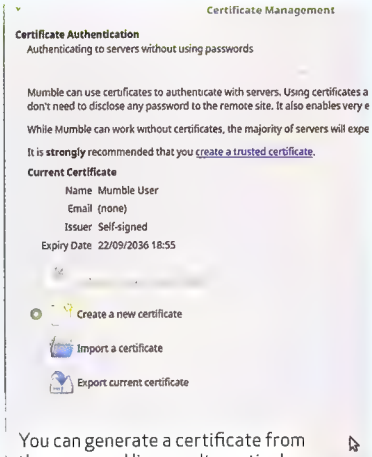
to edit Mumble's configuration. Scroll to the line:

```
ExecStart = /home/mumble/bin/talkiepi
```

Leave a space and type the following:

```
-username yourusername -certificate /home/mumble/mumble.pem  e.g -username rocketman -certificate /home/mumble/mumble.pem
```

Press 'Ctrl-X', then 'Y', then return to save and exit. Reboot the Pi to effect your changes. The Raspberry Pi will now use a TLS certificate when connecting to supported Mumble servers.


Certificate Management
Certificate Authentication
Authenticating to servers without using passwords
Mumble can use certificates to authenticate with servers. Using certificates a
don't need to disclose any password to the remote site. It also enables very e
While Mumble can work without certificates, the majority of servers will expe
It is strongly recommended that you create a trusted certificate.
Current Certificate
Name Mumble User
Email (none)
Issuer Self-signed
Expiry Date 22/09/2036 18:55
Create a new certificate
Import a certificate
Export current certificate

You can generate a certificate from the command line, or alternatively, if you can connect your Pi to an HDMI monitor, use the Mumble client's easy certificate wizard.

electronics supplies stores, but the reliable Jaycar (**www.jaycar.com.au**) sells a pack of eight for just $0.55.

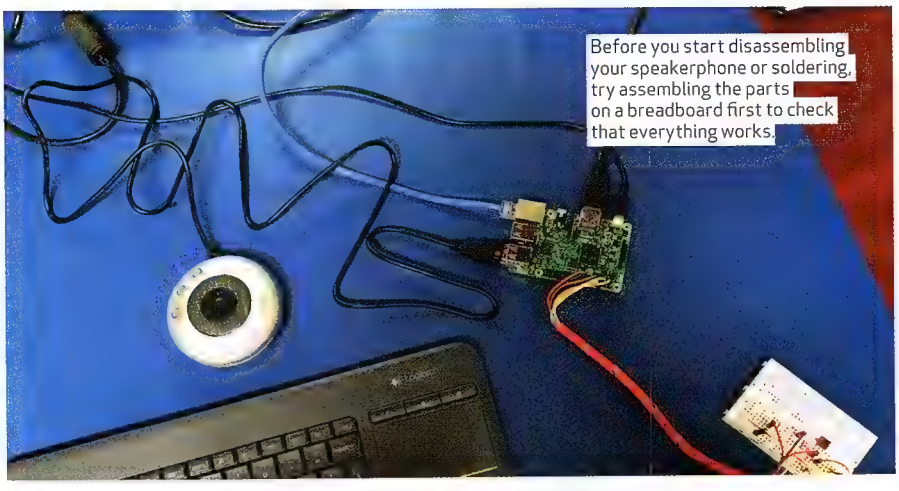
If you plan to use the TalkiePi as a home intercom, you should connect it to mains power, but if you want a truly portable transmitter, consider investing in a battery pack like the PiBorg (discussed more over the page).

If you're serious about assembling this project, you'll also need wire and access to a soldering iron. The Pi Hut sells a handy Breadboarding Wire Bundle of 75 flexible stranded cord wires for just about $5. For the same amount, you can also invest in a half-size breadboard to experiment with. Bear in mind that, if you want to communicate with other people, you will need to double up on the parts you need. However, most of the components come as parts of packs, so you should be able to create as many TalkiePis as you're likely to need.

BUTTONS AND PINS

The basic setup for the GPIO pins is easy to understand. There's an LED built into the pushbutton on the front of the TalkiePI itself which lights up when you're transmitting. There are also two separate 'online' and 'participant' status LEDs.

If this is your first project, it's best to work through the steps on the website on your breadboard before you solder anything, also pay close attention to the GPIO diagram on the website before you start. For full assembly instructions, visit the main project page at **bit.ly/Wi-FiWalkieTalkie**.



Before you start disassembling your speakerphone or soldering, try assembling the parts on a breadboard first to check that everything works.

If you decide to mimic the TalkiePi project, you don't necessarily have to use a 3D-printed case, but it's certainly much handier to have trailing wires boxed up. The actual 3D designs for the casing, as well as the speaker cover are based on a retro walkie talkie and have been uploaded by Daniel Choates to his GitHub page available at **github.com/dchote/talkiepi/tree/master/stl**. The STL (StereoLithography) file format is compatible with most 3D printers.

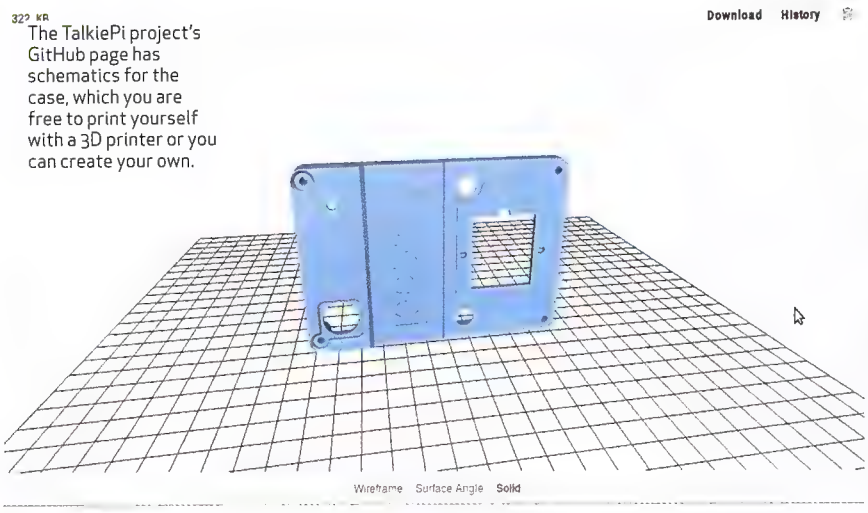
The TalkiePi project was done on a Monoprice Select Mini 3D printer using PLA plastic with 100% infill. PLA has the advantage of giving off a pleasant sugary smell when printing, as well as being quite sturdy.

If you already have a 3D printer, you will most likely be comfortable enough from previous projects to simply manufacture the parts yourself. If you don't have a 3D printer, then you can ask a third-party company to build the top and bottom casing, as well as the speaker cover for you. (Alternatively, find a friend who will loan you theirs.)

In regards to the Mumble server, they are highly customisable and it's possible to create select groups or channels for everyone with whom you wish to talk. For instance, you may prefer that your friends playing *World of Warcraft* can't hear everyone who buzzes your front door intercom. If you do set up your Mumble Server (see box, left) make sure to group conversations together. You may need to use the `go run` command each time you switch channels.

SAFETY IN MUMBLES

To prevent your conversations being monitored, you should also consider



The TalkiePi project's GitHub page has schematics for the case, which you are free to print yourself with a 3D printer or you can create your own.

Image credit: Daniel Chote, http://chote.com

Managing Mumble

In order to make sure your setup is secure, you'll need your own Mumble Server. You can set this up yourself on a separate Raspberry Pi if you only plan on communicating over your home wireless network, say, for an intercom. Alternatively, you can rent a Mumble server online. If you want to play around with a mumble server of your own you can get a free one-month trial at **www.mumble.com/free-mumble-server.php**

Once your server is set up. note down the domain name and its port. You should also think of a username you'd like to register and set up a channel specifically for you and your friends. (The default is Root.) Next, connect to your Pi via SSH or open the Terminal and run the command:

```
sudo nano /home/mumble/gocode/src/github.com/dchote/talkiepi/cmd/talkiepi/main.go
```

to edit TalkiePi's configuration.

Scroll down to the line beginning `server` and replace the TalkiePi server address 'talkiepi.projectable.me:64738' with your own, so natedrake.mumble.com:64248. On the line beginning `/c/username/cend/` , you may wish to insert a permanent username between the quotation marks.

Only enter a password if your Mumble server requires one. If you have previously created a certificate, find the line starting `insecure` and change 'true' to 'false'. Press 'Ctrl-X', then 'Y', then return to save your changes. Finally run:

```
go run /home/mumble/gocode/src/github.com/dchote/talkiepi/cmd/talkiepi/main.go
```

to start the TalkiePi software with your new settings.

generating an SSL certificate for your Mumble client. (See Certified Mumbler box, back over the page.) If you choose to install the standard Mumble client, it comes with its own certificate but you can choose to generate another in your own name by running the certificate wizard. See **www.mumble.com/support/mumble-creating-a-certificate.php** for more information. The steps will allow you to generate a 'self-signed' certificate which is ideal for a small group of people. If you plan to open your Mumble server to the public, you may wish to obtain a trusted certificate from a bona fide Certificate Authority.

CROSS TALK

By default, the TalkiePi software connects to Chote's own Mumble server and generates a username for you automatically. This keeps things simple, but besides not being very fair on Chote's bandwidth, it isn't the most secure setup. (Again, see Managing Mumble to configure TalkiePi with your own Mumble server.)

Technically, you could run the Mumble server software on the same Pi on which you're talking but this can cause network errors, so it's best to have a separate device. If you only plan to use the Pi within the same building, consider having a machine connected to your network dedicated to running Mumble's server software, Murmur.

By default, the Pi may not use the USB speakerphone you've attached as the sound device. If you can connect your Pi to an HDMI monitor, this is fairly easy to fix by right-clicking on the volume button and adjusting your sound preferences. If you have no monitor or the Pi has already been placed in its casing, connect via SSH and run the command `sudo -i` , then `aplay -l` to list all sound devices.

Make a note of the card number of the USB device (most likely it'll be 'card 1'). Next run `nano /usr/share/alsa/alsa.conf` . Scroll down and change `defaults.ctl.card 0` to the corresponding number of your speakerphone. Do the same for `defaults.pcm.card 0` .

If you choose to use a 3D printer to create the casing for the TalkiePI, bear in mind that it was designed specifically for the US Robotics speakerphone listed on the website, so other speakers may not fit in as snugly. Pay careful attention to the size of your components to avoid wasting precious material.

The default setup for the TalkiePi is that the button is used to 'push to talk'. Mumble doesn't have to run this way but it is keeping with old style walkie-talkies. If you want to use Mumble in a different way, such as with a keyboard shortcut or with a headset when you raise your voice, the easiest way is to run the graphical audio wizard with the official Mumble client. Connect your Pi to a monitor, open the Terminal and run `sudo apt-get install mumble` . Next, run `Mumble` and you will automatically be asked to configure your microphone and sound preferences. If you've set up your own Mumble server, you can also use the handy menus to input the details here.

If nostalgia gets the better of you and you decide you prefer an authentic looking walkie-talkie, bear in mind that it will only be effective while connected to the same wireless network on which the Pi was set up. This can be an issue if you need to move the Pi elsewhere, as it's not possible to connect the HDMI cable while it's inside the TalkiePi casing. Instead, connect via SSH and run the command `sudo nano /etc/wpa_supplicant/wpa_supplicant.conf` to edit your network settings. At the very bottom of the file, paste the details of the new wireless network as follows:

```
network={
ssid="yourwifinetworkname"
psk="yourwifipassword"
}
```

Press 'Ctrl-X', then 'Y', then return to save and exit. The TalkiePi is only as good as the battery pack powering it. You can either use a USB battery pack as outlined on the TalkiePi website or, if you prefer a neater solution, you may want to consider using a PiBorg (**thepihut.com/products/battborg?variant=1103793752**). This is a custom power converter for the Pi, which works with most batteries and even comes with an eight-battery AA pack. The Pi Hut website recommends using rechargeable batteries.

The TalkiePi project is a work in progress. Currently, Chote is working on running it on a Pi Zero which would be much smaller and less power hungry. For the latest updates see **github.com/dchote/talkiepi.**

Set up your TalkiePi

```
pi@192.168.1.18's password:

The programs included with the Debian GNU/Linux system are free softwar
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu Sep 22 13:17:09 2016
pi@raspberrypi:~ $ fish
Welcome to fish, the friendly interactive shell
Type help for instructions on how to use fish
pi@raspberrypi ~> sudo -i
root@raspberrypi:~# adduser --disabled-password --disabled-login --geco
ble
Adding user `mumble' ...
Adding new group `mumble' (1001) ...
Adding new user `mumble' (1001) with group `mumble'
```

1 CREATE A MUMBLE USER

Open the Terminal on your Raspberry Pi or connect via SSH and switch to the root user with the command `sudo -i`. Next, create the user by running:

```
adduser --disabled-password --disabled-login
--gecos "" mumble
```

and give it the necessary permissions with the command:

```
usermod -a -G cdrom,audio,video,plugdev,users,
dialout,dip, input,gpio mumble
```

```
Unpacking libopenal-dev:armhf (1:1.15.1-5) ...
Selecting previously unselected package libopus-dev:armhf.
Preparing to unpack .../libopus-dev_1.1-2_armhf.deb ...
Unpacking libopus-dev:armhf (1.1-2) ...
Selecting previously unselected package golang-go.tools.
Preparing to unpack .../golang-go.tools_0.0~hg20140703-4_armhf.deb ...
Unpacking golang-go.tools (0.0~hg20140703-4) ...
Processing triggers for man-db (2.7.0.2-5) ...
Setting up golang-src (2:1.3.3-1) ...
Setting up golang-go-linux-arm (2:1.3.3-1) ...
Setting up golang-go (2:1.3.3-1) ...
Setting up golang-doc (2:1.3.3-1) ...
Setting up golang (2:1.3.3-1) ...
Setting up libopenal-dev:armhf (1:1.15.1-5) ...
Setting up libopus-dev:armhf (1.1-2) ...
Setting up golang-go.tools (0.0~hg20140703-4) ...
root@raspberrypi:~# su mumble
mumble@raspberrypi:/root $ mkdir ~/gocode
mumble@raspberrypi:/root $ mkdir ~/bin
mumble@raspberrypi:/root $ export GOPATH=/home/mumble/gocode
```

2 INSTALL DEPENDENCIES

Switch to your new 'mumble' user with `su mumble`. Next, create the installation directories with `mkdir ~/gocode` and `mkdir ~/bin`. You'll need to create softlinks for these two directories with the command:

```
export GOPATH=/home/mumble/gocode
```

followed by a second `export` command:

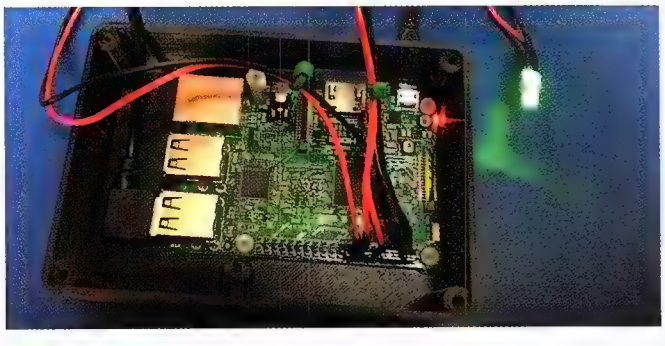
```
export GOBIN=/home/mumble/bin
```

Finally, move to the install directory with `cd $GOPATH`.

```
File  Edit  View  Search  Terminal  Help
reparing to unpack .../golang-go.tools_0.0~hg20140703-4_armhf.deb ...
npacking golang-go.tools (0.0~hg20140703-4) ...
rocessing triggers for man-db (2.7.0.2-5) ...
etting up golang-src (2:1.3.3-1) ...
etting up golang-go-linux-arm (2:1.3.3-1) ...
etting up golang-go (2:1.3.3-1) ...
etting up golang-doc (2:1.3.3-1) ...
etting up golang (2:1.3.3-1) ...
etting up libopenal-dev:armhf (1:1.15.1-5) ...
etting up libopus-dev:armhf (1.1-2) ...
etting up golang-go.tools (0.0~hg20140703-4) ...
oot@raspberrypi:~# su mumble
umble@raspberrypi:/root $ mkdir ~/gocode
umble@raspberrypi:/root $ mkdir ~/bin
umble@raspberrypi:/root $ export GOPATH=/home/mumble/gocode
umble@raspberrypi:/root $ export GOBIN=/home/mumble/bin
umble@raspberrypi:/root $ cd $GOPATH
umble@raspberrypi:~/gocode $ go get github.com/layeh/gopus
umble@raspberrypi:~/gocode $ go get github.com/dchote/talkiepi
umble@raspberrypi:~/gocode $ cd $GOPATH/src/github.com/dchote/talkiepi
umble@raspberrypi:~/gocode/src/github.com/dchote/talkiepi $ go build -o /home/
umble/bin/talkiepi cmd/talkiepi/main.go
```

3 DOWNLOAD AND BUILD SOFTWARE

Run `go get github.com/layeh/gopus` and `go get github.com/dchote/talkiepi` to download all the software. Next, `cd` into the TalkiePi directory with `cd $GOPATH/src/github.com/dchote/talkiepi`. Now build TalkiePi: `go build -o /home/mumble/bin/talkiepi cmd/talkiepi/main.go`. Run `sudo -i` and make TalkiePi boot up every time the Pi restarts: `cp/home/mumble/gocode/src/github.com/dchote/talkiepi/conf/systemd/mumble.service /etc/systemd/system/mumble.service`



4 CONNECT YOUR USB SPEAKERPHONE

Connect the USB speakerphone to an available port on the Pi. At this point, you'll need to refer to the instructions on the TalkiePi website available at **bit.ly/Wi-FiWalkieTalkie** and take it stage by stage. If you print the project's case, it's specifically designed to fit the PI 3 and the US Robotics speakerphone. You attach the right/left angle USB cable to the bottom right USB port of your Pi and will need to mount the Pi and then mount the speaker to the front panel.

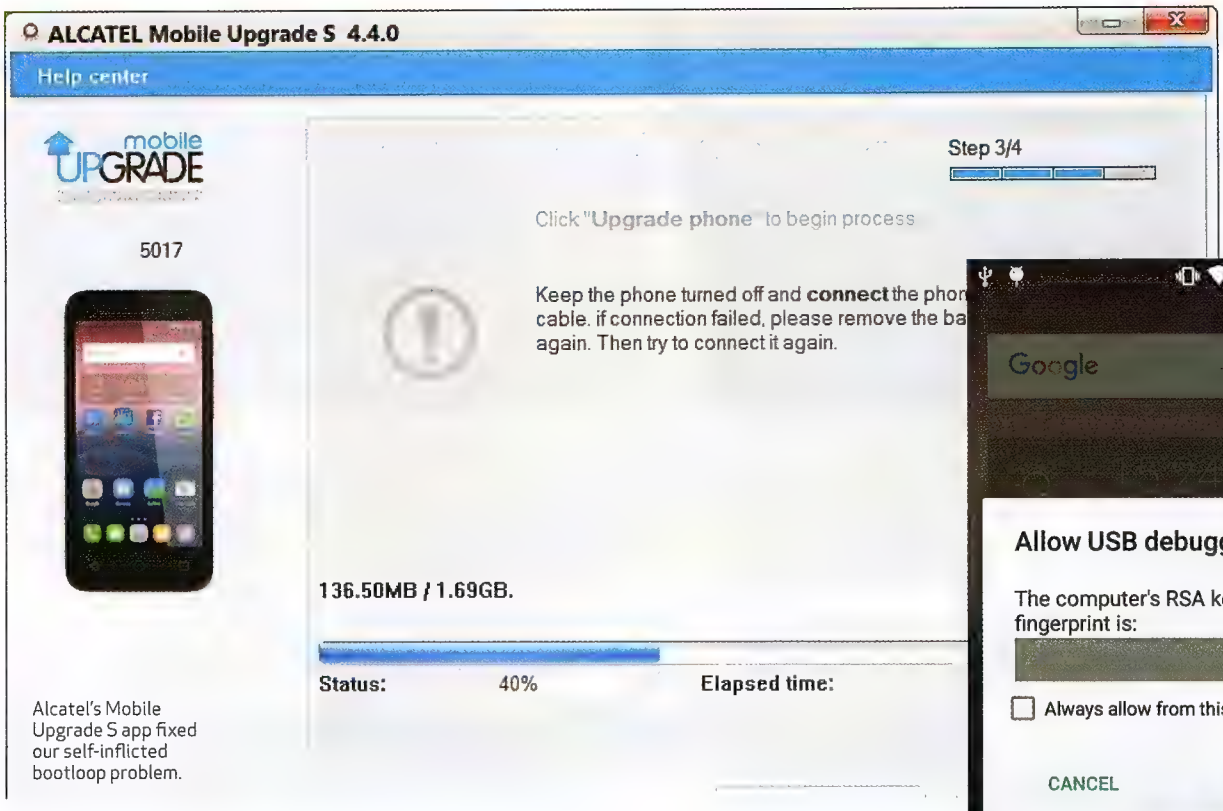
5 OPTIONAL LEDS AND CASING

Again, this optional stage requires following the steps on the project website (**bit.ly/Wi-FiWalkieTalkie**). You need to do such things as solder your positive and negative LED wires to the GPIO pins, add heat shrink to stop shorting, put together the button GPIO connector and position and fasten the LEDs. You can also place the Pi inside an enclosure with a power cable or battery pack.

```
mumble@raspberrypi: /root
File  Edit  View  Search  Terminal  Help
 GNU nano 2.2.6          File: cmd/talkiepi/main.go                Modifi

func main() {
        // Command line flags
        server := flag.String("server", "natedrake.mumble.com", "the server to co
        username := flag.String("username", "rocketman", "the username of the cli
        password := flag.String("password", "", "the password of the server")
        insecure := flag.Bool("insecure", true, "skip server certificate verifica
        certificate := flag.String("certificate", "", "PEM encoded certificate an
        channel := flag.String("channel", "talkiepi", "mumble channel to join by

        flag.Parse()

        // Initialize
        b := talkiepi.Talkiepi{

^G Get Help  ^O WriteOut  ^R Read File  ^Y Prev Page  ^K Cut Text  ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is   ^V Next Page  ^U UnCut Text ^T To Spell
```

6 CONFIGURE MUMBLE SERVER SETTINGS

We recommend certifying your Mumble server so that you don't need to use passwords to connect, which we explain how to do in the box (Certified Mumbler, back two pages). We'd also advise referring to the box (Managing Mumble, opposite) for more information on how to use your own Mumble Server and channel. You can, however, use the TalkiePi Mumble server straight away, if you wish. ■


ALCATEL Mobile Upgrade S 4.4.0
Help center
mobile UPGRADE
5017
Step 3/4
Click "Upgrade phone" to begin process
Keep the phone turned off and connect the phon
cable. if connection failed, please remove the ba
again. Then try to connect it again.
136.50MB / 1.69GB.
Status: 40%
Elapsed time:
75% 15:24
Google
Allow USB debugging?
The computer's RSA key fingerprint is:
Always allow from this computer
CANCEL
OK
You must enable USB debugging on your device before you can run ADB.

Alcatel's Mobile Upgrade S app fixed our self-inflicted bootloop problem.

Hack your Android

Back up your Android device, unlock the bootloader, capture screen videos — all from your PC. Darren Yates explains using Google's ADB and Fastboot command-line tools.

WARNING

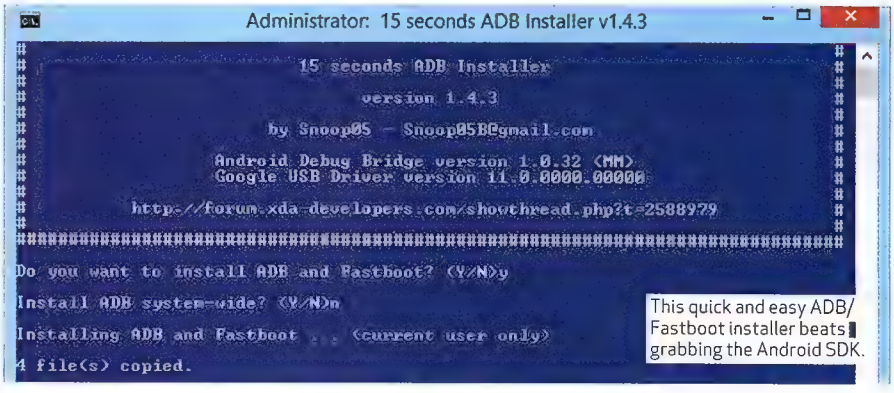
Using the tools described in this story without care can damage your phone or tablet. Use the information in this story at your own risk.

Gaining root access or 'rooting' your Android device is something of a right of passage for any serious Android user. Sure, it might seriously compromise Android's security by allowing unfettered access to the root of the operating system; however, the gains usually outweigh the losses. In fact, so much so, plenty of 'one-click' rooting tools have hit the web in recent years. In many cases, they utilise two Google command-line tools that allow you to interact with and control your device direct from your PC. But ADB and Fastboot are far more powerful and feature-capable than just for flashing ROMs.

ADB AND FASTBOOT

Android Debug Bridge (ADB) is a small utility included in the Android Software Development Kit (SDK) with a big role – it allows the Android Studio IDE (integrated development environment) to communicate with an Android device, whilst running test-builds of apps. ADB streams debug information back to the IDE, so app developers can see bugs and make corrections. However, ADB and its Fastboot cousin also operate from the Windows command-line or Linux terminal. The main difference between ADB and Fastboot is that ADB works with your device's Android OS, while Fastboot gets into your device's bootloader.

Combined, they're a powerhouse toolkit for doing a mountain of backroom hacking of your Android device, whether it's flashing new firmware, sideloading new apps or performing a full backup of your device. Due to variations in Android


Administrator: 15 seconds ADB Installer v1.4.3
15 seconds ADB Installer
version 1.4.3
by Snoop05 - Snoop05B@gmail.com
Android Debug Bridge version 1.0.32 (MM)
Google USB Driver version 11.0.0000.00000
http://forum.xda-developers.com/showthread.php?t=2588979
Do you want to install ADB and Fastboot? (Y/N)y
Install ADB system-wide? (Y/N)n
Installing ADB and Fastboot . . . (current user only)
4 file(s) copied.

This quick and easy ADB/Fastboot installer beats grabbing the Android SDK.

Device Driver Installation Wizard
Completing the Device Driver Installation Wizard
The drivers were successfully installed on this computer
You can now connect your device to this computer. If your device came with instructions, please read them first.
Name
Status
Ready to use
< Back
Finish
Cancel

The 15-second ADB Installer also includes a Google USB device driver install.

releases and firmware changes made by device makers and phone network providers, not all ADB and Fastboot commands will work on every device.

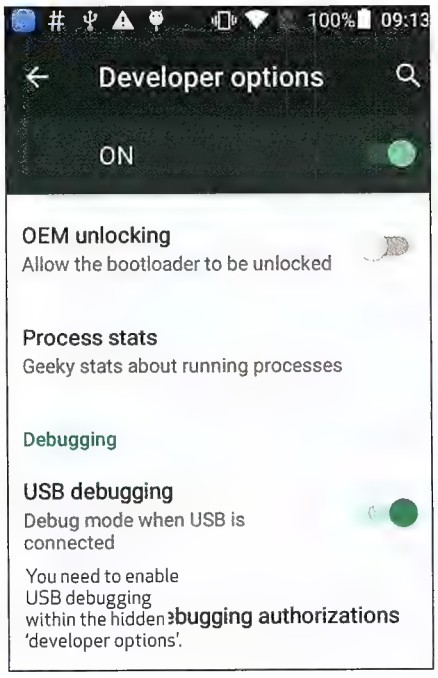
Nevertheless, these utilities will add considerably to your hacking firepower – and brick your device if you're not careful.

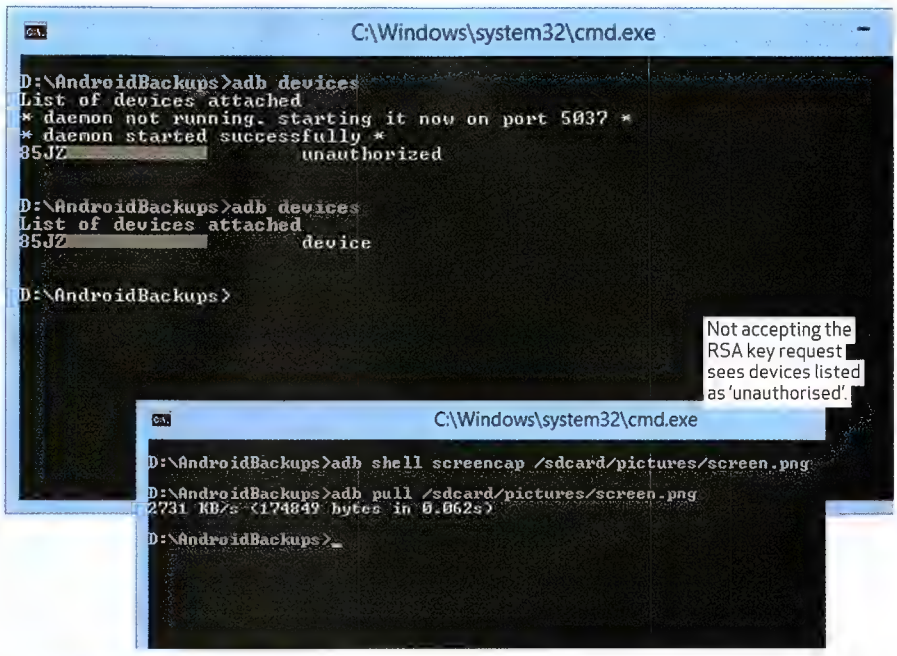
INSTALL IN 15 SECONDS

Rather than install the Android SDK, you can just install ADB/Fastboot via the 15-second Windows installer from XDA Developers (**tinyurl.com/apc438-fastboot**). It's a two-step process – first, you install the ADB and Fastboot files, then choose to install an Android device driver, enabling Windows to talk with your device over USB.

DEVELOPER OPTIONS

After that, you must also enable the hidden 'developer options' in your device's Android OS. Select 'Settings > About phone' and scroll down to the 'build number' entry. Tap it seven times and you'll get the message 'you're now a developer'. Use the back button to go back to Settings, scroll around until you see 'Developer options' and select it. Tap the new 'On' button and do likewise for 'USB debugging'. You should now be ready to fire up ADB.





Not accepting the RSA key request sees devices listed as 'unauthorised'.

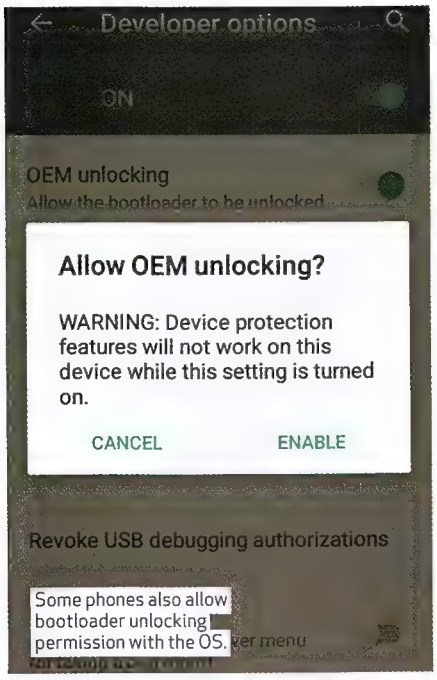
BASIC ADB COMMANDS

Connect your Android device into your Windows PC, launch a Command Prompt on Windows and enter the command:

```
adb devices
```

If you're running at least Android 4.4/KitKat, this command will launch a request on your Android device to accept the RSA security key fingerprint from your PC in order to enable connectivity between the two. The device will also appear as a serial number and 'unauthorised' on the ADB command prompt output. Tap the OK button on the Android panel and run the ADB command again. This time, you should see it change to 'device'. Each Android device listed on the ADB output has a serial number – you use it to select individual devices if more than one is connected. For most ADB commands, you can start with:

```
adb -s <serial_number>
<…command…>
```


Developer options
ON
OEM unlocking
Allow the bootloader to be unlocked
Allow OEM unlocking?
WARNING: Device protection features will not work on this device while this setting is turned on.
CANCEL
ENABLE
Revoke USB debugging authorizations
Some phones also allow bootloader unlocking permission with the OS.

This will direct your commands to that particular device. Can't remember the serial number? Try:

```
adb get-serialno
```

However, you won't need it if you only have one device connected.

GRABBING A SCREENSHOT

One of the many useful built-in features within ADB is the shell, a Unix-style command prompt that allows you to run commands on your Android device. For example, taking a screenshot of your Android device's screen can be a complicated process, thanks to the various Android differences and hardware button combos required. It might also just not be physically possible for one reason or another to operate the button combination activating the screen grab process. ADB provides a consistent option via a shell command, using:

```
adb shell screencap /
sdcard/pictures/screen.png
```

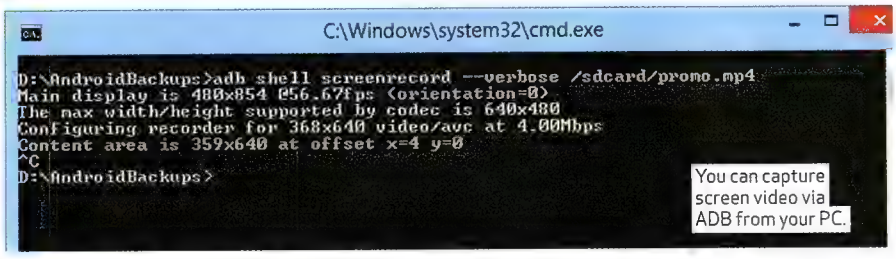
If the path doesn't exist, the command will throw up an error, otherwise, it will grab the screenshot and dump you back to the command prompt. But this only captures the screenshot to your Android device. ADB can download the file to your PC, using the command:

```
adb pull /sdcard/pictures/
screen.png
```

The image file is downloaded to the current path shown on the Command Prompt window.

RECORDING A SCREEN VIDEO

PC training videos are common and relatively easy to do, thanks to a myriad of apps, from Camtasia to CamStudio. On Android, screen-video apps are harder to come by. But provided your device has at least Android 4.4/KitKat, you don't need them. Again, using the shell, you can issue a command to fire up Android's on-board 'screenrecord' utility – it'll capture screen video using H.264


C:\Windows\system32\cmd.exe
D:\AndroidBackups>adb shell screenrecord --verbose /sdcard/promo.mp4
Main display is 480x854 @56.67fps (orientation=0)
The max width/height supported by codec is 640x480
Configuring recorder for 368x640 video/avc at 4.00Mbps
Content area is 359x640 at offset x=4 y=0
^C
D:\AndroidBackups>
You can capture screen video via ADB from your PC.

(AVC) video compression into an MP4 file. The app also has command switches for setting the video bit rate (default is 4Mbps), the capture resolution (1,280 x 720, if possible) and maximum recording time in seconds (180).

The one thing to remember is that it's your Android device capturing the video – depending on its CPU and whatever you're capturing, it may not have enough horsepower to both capture at native screen resolution (always the desired option) and do whatever it is you want recorded. In this case, Google recommends lowering the resolution to give your device a chance. Two possible commands are:

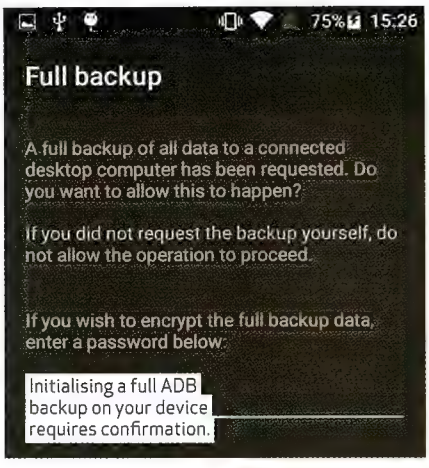
```
adb shell screenrecord --verbose /sdcard/promo.mp4
```

or

```
adb shell screenrecord --verbose --size 640x480 -bit-rate 6000000 /sdcard/promo.mp4
```

The '--verbose' switch delivers output on your PC's command prompt window, so you can see what's going on. The size option is in pixels, the bit rate in bits per second (bps). Recording begins as soon as you issue the command and stops when you press 'Ctrl-C' on your PC's keyboard.

Interestingly, from looking at the file output specs, screenrecord appears to vary the frame rate based on the source, so app-screen videos record fewer frames, while motion videos are captured at roughly original frame rates. For more information, read Google's developer page (**tinyurl.com/apc438-dev**).


75% 15:26
Full backup
A full backup of all data to a connected desktop computer has been requested. Do you want to allow this to happen?
If you did not request the backup yourself, do not allow the operation to proceed.
If you wish to encrypt the full backup data, enter a password below:
Initialising a full ADB backup on your device requires confirmation.

CREATE A FULL BACKUP

If you're about to muck around with your device's firmware, you'd be nuts not to capture a full backup of your device first. That way, should anything go wrong, you can restore the ROM separately, then the backup and continue. While there are plenty of decent apps for doing this, ADB provides a simple alternative. Just issue the command:

```
adb backup -all
```

This initiates the Android 'full backup' system on your device, but before it begins, your device will ask you to confirm the backup, as well as offer the option to encrypt it with a password. Once confirmed, the backup will proceed, again to the current filepath shown in the Command Prompt window, but as the file 'backup.ab'. However, be warned – if you have a 'backup.ab' file already in that folder, it'll be overwritten. The better option is to name the backup file initially. You do that using the command:

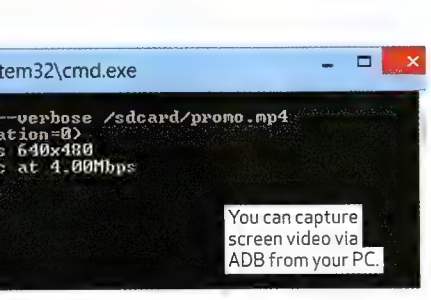
```
adb backup -all -f backup2016_Dec_21.ab
```

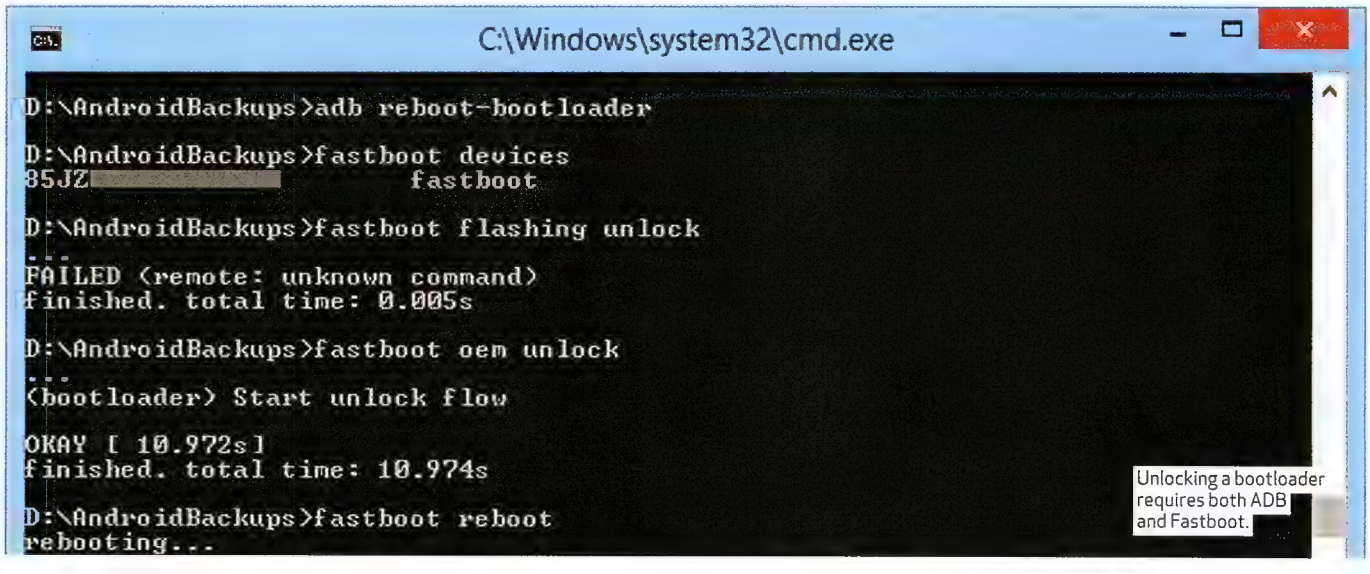
Now again, this assumes you want the file stored in the current Command Prompt filepath. If not, add the full filepath to the filename and add double-quote marks ("") around it if it contains any spaces.

However, somewhat confusingly, 'all' doesn't really mean 'all' – for instance, it doesn't include installed APK packages (your apps). You might assume you can download any APKs you don't back up, but you can't always guarantee they'll be around, particularly the versions you're using now, in which case, you need:

```
adb backup -all -apk -f backup2016_Dec_21.ab
```

You can also add a '-shared' switch to backup data located on the SD card. This overall method doesn't need


100% 19:23
Full restore
A full restore of all data from a connected desktop computer has been requested. Do you want to allow this to happen?
If you did not request the restore yourself, do not allow the operation to proceed. This will replace any data currently on the device!
If the restore data is encrypted, please enter the password below:
You'll also be asked for confirmation before restoring an ADB backup.



root-access, but if you have data lurking behind root privileges, it likely won't work. In that case, Titanium Backup (**tinyurl.com/78v2sg6**) is your best bet.

RESTORE A FULL BACKUP

And, of course, once you've recorded a backup, you want to be able to restore it. To do that, you enter the command:

```
adb restore backup2016_Dec_21.ab
```

This restores the backup, but we found front-page launcher icons were missing. One final warning – according to reports, what doesn't get backed up using this method are your SMSs, so you may want to back up those separately if they matter to you.

CONTROLLING YOUR BOOTLOADER

Every operating system has a bootloader – it's usually the first piece of software that launches after the hardware wakes up and tells the operating system how to load. To ensure the bootloader only loads the genuine Android operating system originally installed on your device, device makers will lock the bootloader – not only that, many also encrypt it, so it can't be tampered with.

For Android power users, that's a problem – if the bootloader is locked, it means you can't install custom ROMs. So before anything else, the first thing you need to do in order to flash a new ROM is unlock the bootloader. The ADB tool is great once you're inside your device's Android operating system, but since the bootloader operates before Android, ADB is no good. To hack into your bootloader, you need Fastboot – but be warned: Fastboot is extremely powerful, meaning you only have to sneeze and it'll wipe your phone clean. And it's probably needless to say at this point, but we'll say it anyway, unlocking your bootloader is usually a rock-solid way of voiding your device's warranty.

Now with that out of the way, for Fastboot to do anything, you first have to boot your device into bootloader mode. This you can do with ADB, using the command:

```
adb reboot-bootloader
```

Once the device has entered bootloader mode, you then use Fastboot in a similar way to ADB. For example, you can list devices and their status using:

```
fastboot devices
```

The next step is unlocking the bootloader itself, but before we get there, you need to know that doing so will wipe your device, so make sure you've completed a full backup of everything first, because it won't be there after the unlock. Google forces a 'factory reset' as a security precaution against unauthorised access to your personal data. While some devices require added software for this, Google Nexus devices can unlock their bootloader with just Fastboot alone, with the command:

```
fastboot oem unlock
```

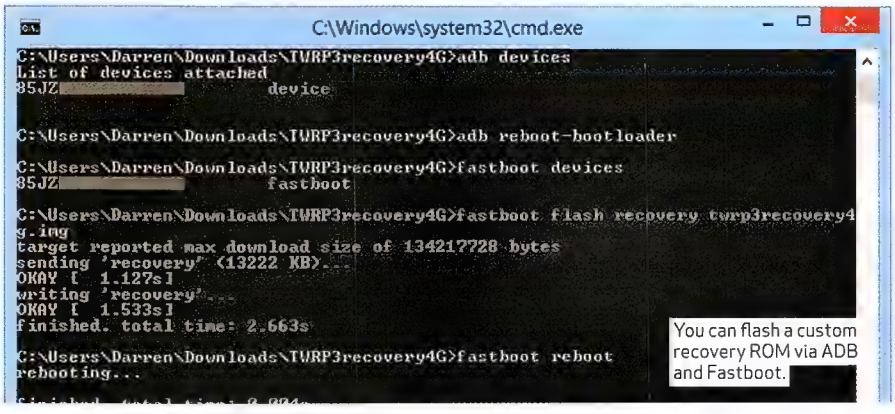
This works with Lollipop/Android 5.1 or older Nexus devices, but late-model Nexus 5X and 6P phones require:

```
fastboot flashing unlock
```

It reportedly should also work for the Pixel and Pixel XL, provided you bought them from Telstra or the Google store. Reports are that Australian-retail Pixel devices come with unlockable bootloaders (**tinyurl.com/apc438-pixel**).

At the moment, it's certain UK and US versions that have non-unlockable bootloaders requiring a hack to force-unlock them. HTC and Motorola devices also require unlock keys (read more at **tinyurl.com/apc438-unlock**).

> "Unlocking your bootloader is usually a rock-solid way of of voiding your device's warranty."



You can flash a custom recovery ROM via ADB and Fastboot.

FLASH RECOVERY ROM

Recovery ROMs allow you to flash updates, wipe the internal cache and clean-reboot your phone when it's not running properly. But installing a custom recovery ROM also allows you to install custom Android ROMs more easily. Once you've unlocked the bootloader, you can install a recovery ROM designed for your specific device using the fastboot command:

```
fastboot flash recovery recovery.img
```

The assumption again is that you launch the Command Prompt at the folder location of your recovery image file. Once flashed, your phone should reboot, but you'll need to reboot into recovery mode to see the change. We tested this on an Alcatel Pixi 3 (4.5) and it worked – eventually.

TROUBLESHOOTING BOOTLOOPS

While many online guides give the impression unlocking your device's bootloader is fairly much 'smooth sailing', sometimes, it's anything but. If your device is already rooted and has a recovery ROM installed, attempting to unlock the bootloader may well push it into a continual boot cycle called a 'bootloop'. We tried this all out on an Alcatel Pixi 3 (4.5) phone, which I'd forgotten had already been rooted. Sure enough, the unlock process finished and the phone wouldn't boot. What's more, we couldn't get into recovery or bootloader modes to fix it.

The only solution was Alcatel's own Mobile Upgrade S utility, which cleverly flashed the phone without powering it up. The download is sizeable, but 20 minutes after the update and ten minutes into the first boot, the phone was back up and running. We then confirmed the phone was back to original condition (sans root) and re-ran the `fastboot oem unlock` command. This time, it worked and we were able to flash TWRP recovery ROM.

TREAD CAREFULLY

This is only a taste of what ADB and Fastboot can do and we recommend you research more before attempting to use them, especially Fastboot. You can still get into mischief using ADB, but Fastboot is on a different plain in terms of its potential to cause complete mayhem if you're not careful with it. They're definitely not to be taken lightly – but together, they can do a heck of a lot. ■

Arduino Troubleshooting 101

Not every Arduino project goes to plan. Being able to troubleshoot is a vital skill for any electrical engineering project. Darren Yates explains.

Arduino provides infinite options for making your own computing projects. But just like writing code, it's rare that a project will work perfectly the first time you power-up. The science (or, sometimes, black magic) of 'troubleshooting' is an important skill to learn and one best learnt by practice.

IT DOESN'T WORK

Look on almost any maker website at almost any project presented and, chances are, there'll be a comment somewhere along the lines of 'I built this and it doesn't work', followed by a few choice words we can't publish. No matter how good you are, few projects ever work first-go. It's just the nature of the beast.

But unfortunately, this is often the point at which many people give up. Like everything in life, it's from your mistakes that you learn most – and it's also how you best hone valuable troubleshooting skills.

A METHODICAL MINDSET

Troubleshooting anything is about patience and having a methodical mindset – you start looking for the easiest, most obvious areas first and progressively dive deeper into your project design once the obvious things have been checked. Here's my basic list:

A digital multimeter can check wiring continuity of unpowered projects.

1. WIRING

Wiring is always the first thing to check. Make sure you understand how your project goes together and that the wiring makes sense. Remove the power first and check for things like correct voltage polarity, loose connections and even components in the wrong way around. I reckon at least half of the problems I've read online regarding Arduino projects are solved by the builder checking the wiring and finding they made a mistake.

2. SIGNAL FLOW

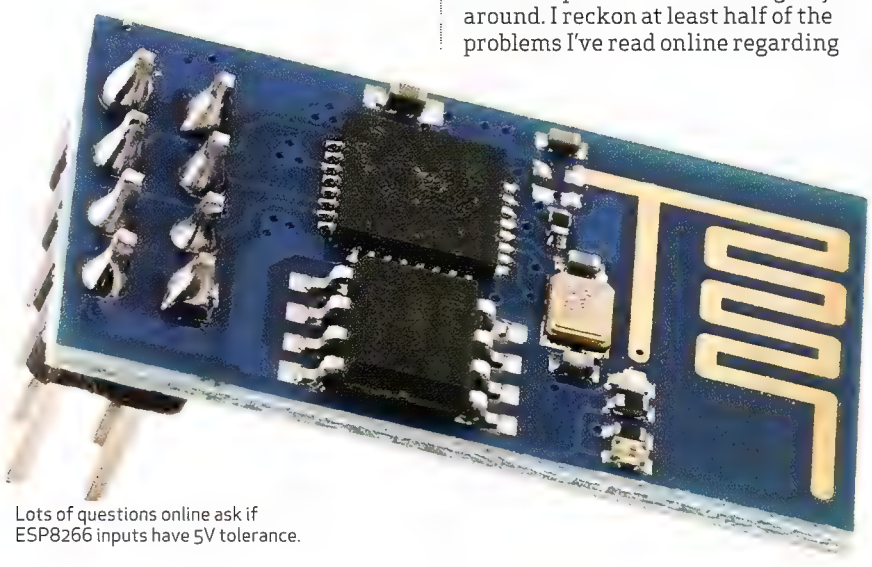
A few years ago, a mate asked me to look at his Fender guitar valve/tube amplifier – all he could tell me was it suddenly stopped working and made a buzz. Taking care for the dangerous 500VDC voltages inside, I was able to follow the audio signal path with a circuit diagram from input to output and traced the fault to an ageing resistor that had gone open-circuit (internal broken connection).

Yet even in modern microcontroller-powered circuits, you need to similarly identify the digital signal flow – understand the point of origin and follow where that signal is supposed to travel.

Check also for 'continuity', that each wire has a good low-resistance connection between the wiring points. For example, if I have a robot where one motor isn't spinning, I'll take a digital multimeter (DMM) on a low or auto 'ohms' range, connect the DMM probes to the two ends of each wire and check for a 'zero ohms' reading or very close to it. If the DMM reads in 'megaohms', it's either a 'dry-joint' (a poor solder joint) or a wire that's gone open-circuit, meaning there's no electrical connection between the two points. Always remove the power before testing anything.

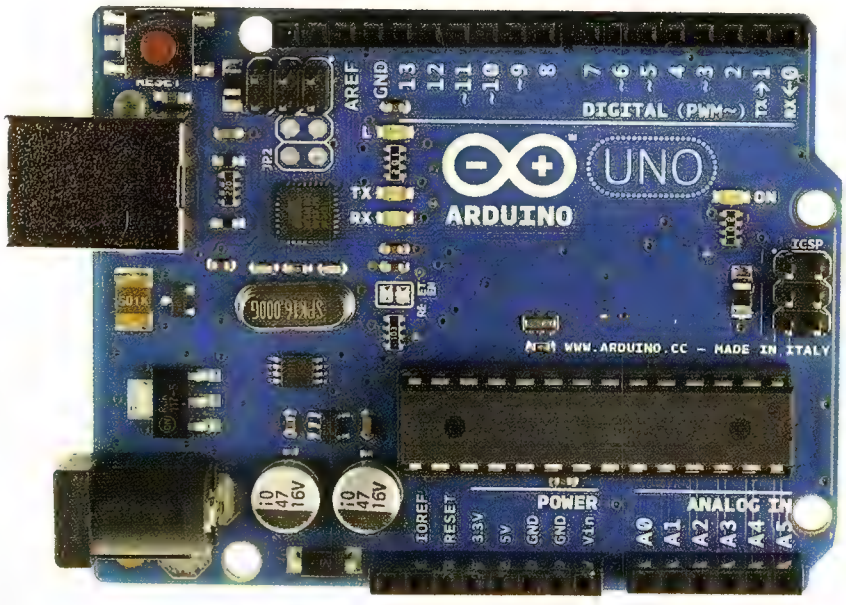
3. CODE FLOW

Bringing microcontrollers into your projects adds the dimension of code errors or 'bugs'. Very quickly, there are two error types – 'syntax' errors or obvious boo-boos such as wrongly-spelt keywords or missing semi-colons at the end of a codeline (if we're talking Java/C++), and 'logical' errors, or errors of code logic, where digital data paths don't align correctly. Logical errors are much harder to find. You can have perfect electrical wiring, but your code is causing problems. That's why I aim to design and code projects one section at a time. For example, I always start by getting an LED to light up or a motor to spin – just to be sure the component works. When building a house, you start at the



Lots of questions online ask if ESP8266 inputs have 5V tolerance.

Understanding code flow is as important to projects as your electronics.



Older Arduino boards like the Uno need 5VDC power.

foundations, get those right, then work on the frame, electrical and plumbing – it's only after that the Gyprock goes on. Being methodical is key.

WATCH YOUR POLARITY

In electronics, 'polarity' describes how power must be applied to a component or device. A common convention is the 'Vcc' label refering to the positive (+) pin, connecting to your project's positive supply rail, while 'GND' is the ground or 0V rail. Not all components have polarity requirements – for example, resistors, polyester capacitors and inductors. But many components do – transistors, CPUs, LCD/OLED panels and most electrolytic capacitors. You have to ensure correct polarity for these components. Otherwise, they'll blow up – sometimes, literally.

And when it comes to Arduino add-on modules, you'll find consistency is not always guaranteed. Check the photo of these 0.96-inch OLED panels (below). They look identical – they're the same size, have the same resolution, use the same chip. But take a close look at the header pins – the panel on the left has the left-most pin as the GND pin and VCC next to it. On the other panel, they're reversed. Frankly, I'd like to meet the genius who thought swapping these pins was a great idea. That aside, the new panel on the right is now flooding the market – this means if you're building any of our previous projects using one of these panels, you must carefully check the power pin wiring polarity before you plug in the panel and power up your project. Otherwise, you'll toast the panel.

5V TOLERANCE

The other big issue is known as '5V tolerance'. Older Arduino boards like the Uno and Nano require 5VDC to run – not just for power, but also for the digital logic-level inputs. Here, a 'high' or 'digital-1' input level is assumed to be

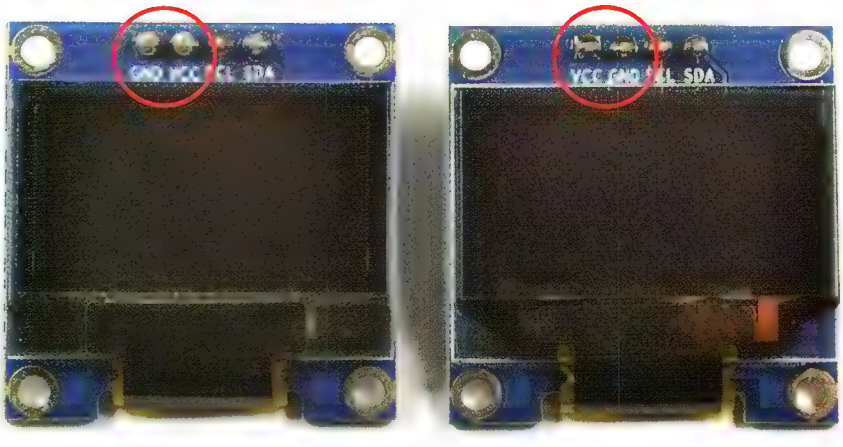
Most components, including motors, have voltage polarity — check first.

5V and a 'zero' is GND or zero-volts. However, more modern ARM Cortex M-series chips, like those found in your fitness band or smartwatch, require 3.3VDC power. Now, you can typically connect a 3.3VDC digital output to the input of a 5V chip and it will work. However, the big question is whether you can safely connect a 5VDC digital signal to the input of a 3.3V chip. Technically, the input signal being applied here is 'over-voltage' and, in many cases, this voltage level will blow up the input circuitry of the 3.3V chip. But in other 3.3V chips, the inputs are designed to handle this specific over-voltage – these inputs are called '5V tolerant'.

This might all sound a bit geeky, but it's a question commonly asked of the popular ESP8266 Wi-Fi chip powering many Internet of Things projects (the chipmaker's CEO has recently said the ESP8266 is 5V-tolerant, **tinyurl.com/jhqga8b**).

BE PERSISTENT

Forget being 'passionate' about making stuff – be persistent, instead. Troubleshooting is better served by having perseverance, backed by a methodical mindset – it's a skill that will make you invaluable to any business. ■



OLED panels with reversed polarity — check your wiring before installation..

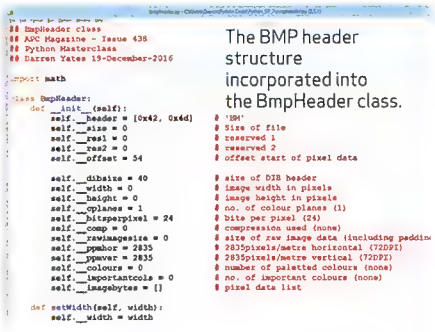
Python coding — Part 7: Object-oriented programming

It's the fundamental computing principle driving much of today's code development. Darren Yates explains the basics of object-oriented programming.

Over the last six issues, we've covered the nuts and bolts of coding Python apps – from variables to if-else statements, loops to functions, lists to file operations. But to make the most of modern programming languages like Python and to take your code to the next level, you need to grab hold of some computer science theory and learn the principles of object-oriented programming (OOP). Not everyone loves OOP, but it's the basis for many programming jobs and gets you thinking in a more organised way, where the focus is more towards objects you want to model.

Get the files

Here's what you'll need for this month's masterclass:
Python 3.5 — www.python.org/downloads
Python Masterclass source code — apcmag.com/magstuff



The BMP header structure incorporated into the BmpHeader class.

THINKING IN OBJECTS

Just about every app you'll write involves some object, whether it's something physical, such as a smartphone or a car, or something more abstract, such as a train timetable or bank account. Even games are full of objects – spaceships, balls, missiles, hedgehogs, lums, Italian plumbers...

Think about your smartphone – there are some basic parameters or 'attributes' you'll find in every model. For example, regardless of whether it's iOS or Android-powered, each one has a screen, an SoC (System on a Chip) processor, RAM, battery and some flash storage. They'll have some form of wireless network connectivity (Wi-Fi and/or Bluetooth) and phone network connectivity (3G or 4G).

In Python, as well as other OOP-ready programming languages, we can represent and group these attributes with a template or 'class'. A class describes not just the object's attributes, but also the functions that can be performed on those attributes.

The simplest way to think of a class is as a cookie cutter. You can make a bunch of cookies that look the same by stamping them out with a cookie cutter – in the same way, the class acts as a template for creating multiple objects based on that one class. These objects are known as 'instances'. Each instance is unique, but it includes or 'inherits' all of the class' attributes and functions.

```
File  Edit  Format  Run  Options  Window  Help
## bank.py
## APC Magazine - Issue 438
## Python Masterclass
## Darren Yates 19-December-2016

import bankaccount

acc1 = bankaccount.BankAccount()
acc1.set_name("Philip")
print("Account created. Name:",acc1.get_name())
print("Account number:", acc1.get_accNumber())

acc2 = bankaccount.BankAccount()
acc2.set_name("Betty")
print("\nAccount created. Name:",acc2.get_name())
print("Account number:", acc2.get_accNumber())

acc1.depositCash(200.00)
acc2.depositCash(500.00)
print("\nAccount balance (acc1):", acc1.get_balance())
print("Account balance (acc2):", acc2.get_balance())

acc1.withdrawCash(100.00)
acc2.withdrawCash(475.00)
print("\nAccount balance (acc1):", acc1.get_balance())
print("Account balance (acc2):", acc2.get_balance())
```

Bank accounts are abstract objects you can model with classes.

EXAMPLE: HOME BANK

A really simple example to help understand how classes work is building your own bank – no, not a real bank, just a simulation that lets you create multiple bank accounts for keeping track of each family member's riches. Since a bank account is an object, however abstract it maybe, we can represent or 'model' it as a class that can later stamp out bank account instances.

So what are its attributes? Every bank account has a user's name, an account number, account balance and a savings interest rate. If you borrow money (that is, your account balance goes negative), you pay a loan interest rate. That'll do for starters. Now what about functions? You can open an account, make a deposit, make a withdrawal, get the account balance and close an account.

BANKACCOUNT CLASS

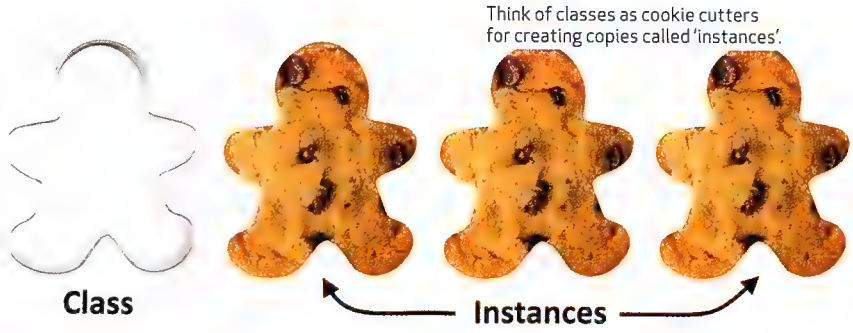
The first step is to create a class using the 'class' statement. It finishes with a colon (:) and is then followed by a series of functions using the 'def' statement. The first, called '__init__(self)' is the 'constructor'. When we call the class to create a new object instance, this constructor function is automatically called to initiate the new instance – think of it as the 'cookie cutter moment' when we stamp out the instance. The 'self' parameter refers to the new instance and the dot notation signifies the following variables belong to that particular instance.

DATA ENCAPSULATION

One of the major reasons for using

classes is that it allows you to control how variables are used. A class is typically made available for programmers to use, but you may not want them to access every variable. For example, we don't really want a programmer to access the 'account_number' variable – you can imagine the chaos it'd create if account numbers are changed erroneously. The use of double underscores (__) preceding the variable name hides these variables from the outside world and they are only visible to the class itself. We say they are now 'private' variables. But since we still need to be able to access the variable values in a controlled way outside of the class, how do we do it? The solution is to create specific functions called 'getters', for retrieving data from these private variables, and 'setters', for setting or changing them. The functions in the BankAccount class 'get_name()' and 'set_name()' are examples. Setters take a parameter and assign or apply that value to the selected variable, while getters usually just return the value of a private variable.

This whole idea is called 'data encapsulation' and it allows us to hide the bits of code within the class and give the user clean, but controlled access to certain class attributes and functions. Finally, the BankAccount class is saved in a file called 'bankaccount.py'.



Think of classes as cookie cutters for creating copies called 'instances'.

"A class is typically made available for programmers to use, but you may not want them to access every variable."

SIMPLE INSTANCE EXAMPLE

Now with the BankAccount class in place, we can use it in our code. We've created a file called 'bank.py' into which we import the bankaccount file using 'import bankaccount'. The files must exist in the same filepath or else you'll end up with a run-time error. Next, we create two bank accounts, acc1 and acc2, using the BankAccount class constructor. We set the username for the account, print the account number, deposit and withdraw some cash, each time printing out the current account balance.

It should appear pretty straightforward stuff. However, there's one thing that might not make sense – if variables are specific to an instance (which they are), how can we create and keep track of a unique account number if each account instance has its own account number variable?

Go back to the BankAccount class and you'll notice straight under the class statement the variable '__account_number'. Because it lives at the top of the class outside of any class function, it's designated a class variable, not an instance variable – if you're coming from a C++/Java background, it's basically a 'static' variable tied to the class and retains a single value, regardless of how many instances we stamp out.

bankaccount.py - C:\Users\Darren\Python Code\Python_EP_7\bankaccount.py (3.5.1)

File Edit Format Run Options Window Help

```
## BankAccount class
## APC Magazine - Issue 438
## Python Masterclass
## Darren Yates 19-December-2016

class BankAccount:

    __account_number = 0

    def __init__(self):
        self.__balance = 0
        self.__save_interest = 0.03
        self.__loan_interest = 0.075
        BankAccount.__account_number += 1
        self.__accountNo = BankAccount.__account_number
        self.__name = ""

    def set_saveIntRate(self, saveint):
        self.__save_interest = saveint/100

    def set_loanIntRate(self, loanint):
        self.__loan_interest = loanint/100

    def set_name(self, name):
        self.__name = name
```

The BankAccount class incorporates data encapsulation and class variables.

Python 3.5.1 Shell

File Edit Shell Debug Options Window Help

```
Python 3.5.1 (v3.5.1:37a07cee5969, Dec  6 2015, 01:54:25) [MSC v.
1900 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: C:\Users\Darren\Python Code\Python_EP_7\bank.
py ==========
Account created. Name: Philip
Account number: 1

Account created. Name: Betty
Account number: 2

Account balance (acc1): 200.0
Account balance (acc2): 500.0

Account balance (acc1): 100.0
Account balance (acc2): 25.0
>>>
```

Each new bank account is an instance of the BankAccount class.

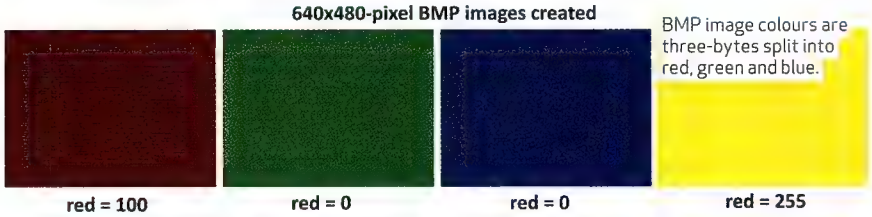
```
import bmpheader

print('APC Magazine - Simple BMP image maker')
imageWidth = int(input("Enter image width (p
imageHeight = int(input("Enter image height (pixels) : "))
cRed = int(input("Enter RED value (0-255)      : "))
cGreen = int(input("Enter GREEN value (0-255)    : "))
cBlue = int(input("Enter BLUE value (0-255)     : "))
filename = input("Enter filename to save       : ")

my_image = bmpheader.BmpHeader()
my_image.setWidth(imageWidth)
my_image.setHeight(imageHeight)
my_image.setColour(cBlue, cGreen, cRed)
my_image.writeBmp(filename)

print("Image has been created.")
print(" --- image width :",my_image.getWidth())
print(" --- image height:",my_image.getHeight())
print(" --- image size  :",my_image.getSize()/1000,"KB")
```

Creating BMP images from scratch is easier to do using a BmpHeader class.

```
def writeBmp(self, filename):
    bmp_file = open(filename, 'wb')
    # BMP header
    bmp_file.write(self.__header[0].to_bytes(1, b
    bmp_file.write(self.__header[1].to_bytes(1, byteorder='little'))
    bmp_file.write(self.__size.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__res1.to_bytes(2, byteorder='little'))
    bmp_file.write(self.__res2.to_bytes(2, byteorder='little'))
    bmp_file.write(self.__offset.to_bytes(4, byteorder='little'))
    # DIB header
    bmp_file.write(self.__dibsize.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__width.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__height.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__cplanes.to_bytes(2, byteorder='little'))
    bmp_file.write(self.__bitsperpixel.to_bytes(2, byteorder='little'))
    bmp_file.write(self.__comp.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__rawimagesize.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__ppmhor.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__ppmver.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__colours.to_bytes(4, byteorder='little'))
    bmp_file.write(self.__importantcols.to_bytes(4, byteorder='little'))
    # start of image array
    for pixelbyte in self.__imageBytes:
        bmp_file.write(pixelbyte.to_bytes(1, byteorder='little'))
    bmp_file.close()
```

The writeBmp function writes header and pixel data as bytes to a binary file.

640x480-pixel BMP images created

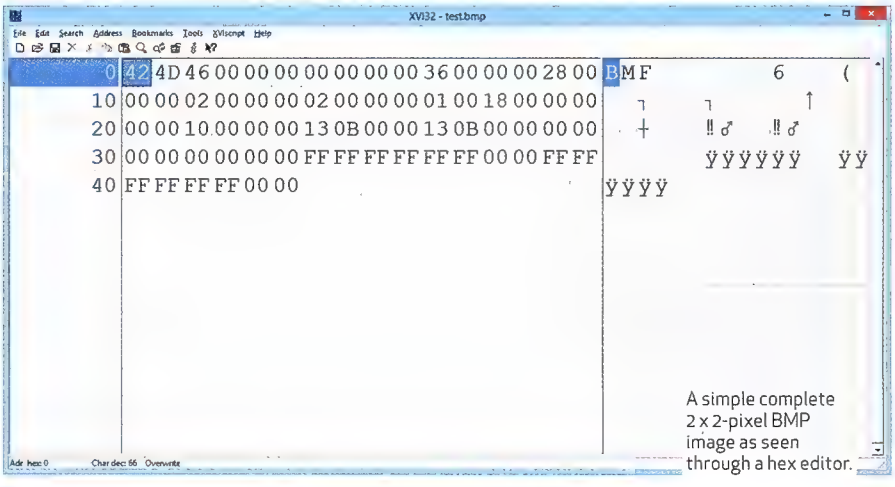


BMP image colours are three-bytes split into red, green and blue.

red = 100	red = 0	red = 0	red = 255
green = 0	green = 100	green = 0	green = 255
blue = 0	blue = 0	blue = 100	blue = 0

Offset	Size	Hex Value	Value	Description
			BMP Header	
0h	2	42 4D	"BM"	ID field (42h, 4Dh)
2h	4	46 00 00 00	70 bytes (54+16)	Size of the BMP file
6h	2	00 00	Unused	Application specific
8h	2	00 00	Unused	Application specific
Ah	4	36 00 00 00	54 bytes (14+40)	Offset where the pixel array (bitmap data) can be found
			DIB Header	
Eh	4	28 00 00 00	40 bytes	Number of bytes in the DIB header (from this point)
12h	4	02 00 00 00	2 pixels (left to right order)	Width of the bitmap in pixels
16h	4	02 00 00 00	2 pixels (bottom to top order)	Height of the bitmap in pixels. Positive for bottom to top pixel order.
1Ah	2	01 00	1 plane	Number of color planes being used
1Ch	2	18 00	24 bits	Number of bits per pixel
1Eh	4	00 00 00 00	0	BI_RGB, no pixel array compression used
22h	4	10 00 00 00	16 bytes	Size of the raw bitmap data (including padding)
26h	4	13 0B 00 00	2835 pixels/meter horizontal	Print resolution of the image,
2Ah	4	13 0B 00 00	2835 pixels/meter vertical	72 DPI × 39.3701 inches per meter yields 2834.6472
2Eh	4	00 00 00 00	0 colors	Number of colors in the palette
32h	4	00 00 00 00	0 important colors	0 means all colors are important

The breakdown of the BMP image header details the various parameters.



A simple complete 2 x 2-pixel BMP image as seen through a hex editor.

If we now look more closely at the '__init__' constructor, you can see we increment this class variable by using the 'BankAccount.__account_number' notation, indicating this variable belongs to the class, not any instance. But what we do next is then assign its value to the instance's hidden '__accountNo' variable. This way, every new account increments the class' account number variable, with the new value becoming the new instance's account number. And by hiding this class variable as a private variable with the double-underscores, programmers can't access it outside of the class.

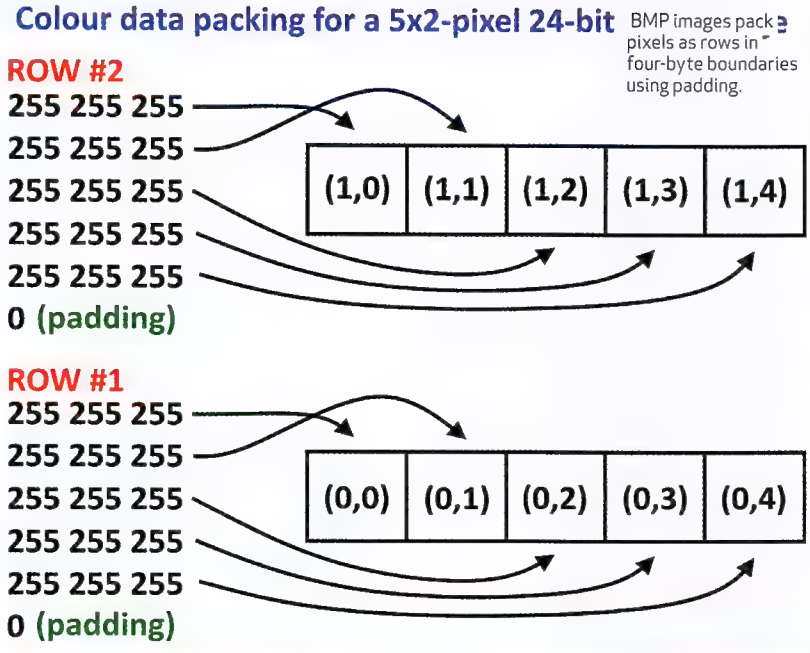
Bottom line, if you need to assign a unique code or ID to an instance of a class, setting up and incrementing a class variable is one way to do it.

EXAMPLE: MAKING BMP IMAGES

A more complex example that follows similar lines is creating simple BMP (bitmap) images from scratch. Bitmap images have been around since Windows 2 and they're very similar in structure to WAV audio files – they have a header section containing the main parameters of the file, followed by the structured data for each individual image pixel. For the BmpHeader class (in bmpheader.py), we took the header structure from the Wikipedia page (**tinyurl.com/bp88myl**).

A standard 24-bit BMP image file has three main sections – the initial 14-byte file header, followed by a 40-byte DIB (device-independent bitmap) 'BITMAP INFOHEADER' header and the image pixel data

Each individual pixel in a 24-bit colour BMP image is made up of three bytes – one byte for each of the primary video colours green, blue and red. Pixels are packed away in rows, starting at the bottom left-corner of the image. Each pixel's three-byte colour data from that bottom row is then added to the data structure. However, the rule is that rows must finish on a four-byte boundary, meaning that if, say, you have a row of five pixels, five pixels times three bytes




```
Python 3.4.3 Shell
File Edit Shell Debug Options Window Help
Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.1600 32 bit
(Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ========== RESTART ==========
>>>
APC Magazine - Simple BMP image maker
Enter image width (pixels)  : 640
Enter image height (pixels) : 480
Enter RED value (0-255)     : 100
Enter GREEN value (0-255)   : 0
Enter BLUE value (0-255)    : 0
Enter filename to save      : testred.bmp
Image has been created.
 --- image width : 640
 --- image height: 480
 --- image size  : 921.654 KB
>>>
```

Enter the image size, colour fragments and filename: the code does the rest.

gives 15 bytes – to make it 16 bytes, we have to add a 'padding' (zero) byte to the end. After that, the second-from-bottom row of pixels is added in the same way and this continues until the top row is added. The header sections contain the details on image width, height, colour depth and file size that allows any image viewer to process the file and display the expected image.

BMPHEADER CLASS

If you follow the Wikipedia outline of the BMP headers, you'll see we've pretty much replicated the fields in the BmpHeader class. Again, we've incorporated data encapsulation with getters, setters and private variables to ensure the end user doesn't get in and muck around with the individual header fields.

When it comes to other functions, setColour() does quite a bit in its seven lines of code, calculating the number of bytes in a row including padding, the size of the raw image data in bytes, the size of the image file including header in bytes, a list of pixel bytes equal to the horizontal pixel count, a secondary list of padding bytes to meet the four-byte boundary, the complete row pixel data list with padding and the total image data list.

Strictly speaking, this is far more than is alluded to by the 'setColour()' function name and it does limit image creation to just single blocks of colour. But this is just a quick mock-up to show how classes work. As always, there are other ways you could build this class. Nevertheless, the result is still a BMP header and pixel data list correctly formatted and padded to four-byte row boundaries, ready to save to a BMP file.

HEX EDITOR

One of the best ways to examine file headers is using a hex editor – it takes in any file type and opens it up in binary format, allowing you to see each byte value as a pair of four-bit hexadecimal (0-9, A-F) characters. Hex editors usually show two panes – the left detailing raw hex values, the right displaying the ASCII equivalent. There are a number of free editors available – XIV32 (**tinyurl.com/yw5yp**) is small and easy to use, but there are others.

BMP image created by bmpmaker.py viewed through Windows Photo Viewer.

BMPMAKER

With the class ready to go, we've put together a simple app that allows you to create a single-colour background BMP image – you can set the width and height in pixels, and set the RGB colour using three 8-bit numbers from 0 to 255. Lastly, you can choose the filename for the image. For simplicity, there is no existing file check, so if a file of the same name already exists in the current app folder, it'll be overwritten.

Complicating things a little is the fact that the BMP header requires data types of varying sizes – for example, some information fields are stored as two-byte words, others as four-byte. As Python does not allow you to specify a data type when initialising a variable, we need to convert the data into bytes and write these individual bytes in 'little endian' form to the required binary-format file. The whole process is a little complicated and not particularly fast, but it shows that you can do quite complex binary tasks using just the Python language we've covered to-date.

By incorporating the BMP header info into a separate class file, the actual 'bmpmaker.py' code is only 17 lines, the code creating the BMP file is just five.

WHAT'S WRONG WITH OOP?

One of the applauded features of OOP is the reusable code it allows you to make. However, many believe OOP can also result in bulky, sluggish and less optimised code. Globally, we're creating data on a scale that is quickly exceeding our abilities to handle (hence the dollars being thrown at quantum computing). There's plenty of discussion and research going into code optimisation, but nevertheless, OOP can help simplify the task of modelling objects, making it one of the most popular programming paradigms you'll find in industry.

MORE TO COME

There's plenty more to learn about object-oriented programming, but we'll cover it on a 'needs' basis. Classes make thinking in objects much easier – they're also the basis for creating everything from GUI (graphical user interface) apps to games in Python. If you're used to the more 'procedural'-style coding we've done until now, OOP can take a bit of getting used to but the rewards are well worth it. ■

downtime

SEALEY

My main 1s and 0s.

FROM $89.95 | PC, PS4, XO | WWW.WATCHDOGS.COM

Watch Dogs 2

Despite a smooth transition to the PC, the stealth can't quite hack it.

Hackers are often portrayed as computer savants hunched over a keyboard, writing script faster than the characters can appear on a dirty CRT. *Watch Dogs 2*, an open-world action adventure set in the San Francisco Bay Area, turns hacking into a full contact sport.

It's the GTA template of a city, cars, guns and ragdoll physics, but you can also use a phone to remotely overload a circuit box and knock out security guards or hack underground pipes to blow up huge sections of the street. (Yes, you can hack pipes.) It rarely feels like you're using technical expertise to give big, insidious tech companies the run around. Instead, you're using brute force.

Even if you're murdering people to steal data, *Watch Dogs 2*'s loose take on pop culture hacktivism assumes a more bizarre, self-aware direction for the series than before. There's a lot of goofy open-world fun to be had mostly as a byproduct of the chaos your abilities enable, and especially by combining abilities in the free roam co-op mode. But the game's stealth systems are undermined by hacking and combat abilities that feel too unwieldy and passive to be reliable, and as slapstick as it can be, relying on the same powers throughout the 30-hour runtime turns the game's best abilities boring far too soon.

The biggest lesson *Watch Dogs 2* learned from its predecessor is that we're a tired of mopey, edgy protagonists, of which Aiden Pearce was a case in point. This time around, Marcus and his support cast in the hacker collective DedSec are likeable, funny people, and it's good to see a black lead in a big-budget game. Marcus and his friends are upbeat and know how to laugh.

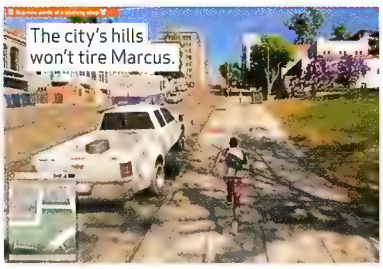
The main missions typically task Marcus with extracting or sabotaging data from a heavily guarded building, often an obvious stand-in for the known Silicon Valley giants (Google is Nudle, for instance). Simple AI guards patrol the arenas, and using two new RC drones — one wheeled, the other airborne — you can scout out the area, marking enemies and interactive tech.

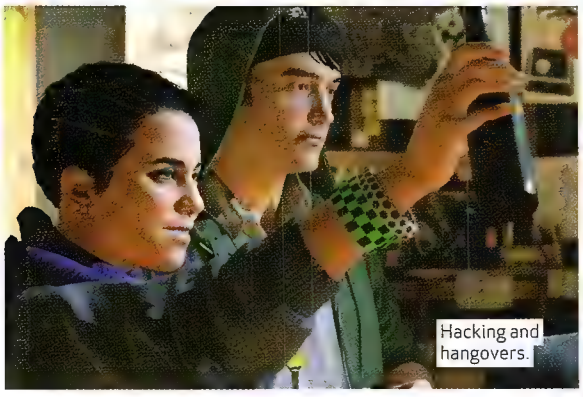
Because you have hacker smarts, you're able to use drones, security cameras or Marcus to interface with CTOS, an operating system embedded into city infrastructure, which means you can remotely influence anything connected to the system, like traffic lights, robots and those handy explosive pipes, just by looking at them and pressing a button. For instance, if you're trying to climb a building to get a clear vantage point, you can hack a massive construction crane, rotate it and lower the platform on the end to scale the tallest buildings in the city. Drive a motorcycle onto that thing, take it up to the highest point,and you can attempt to infiltrate a few outdoor enemy bases. It didn't work for me, but I laughed a lot, and it was more interesting than shocking guards with circuit boxes or calling in mob hits to murder them.

To truly be stealthy, you'll spend a lot of time controlling your drones. Snaking around most spaces are ventilation shafts just big enough for a small RC robot to roll through, but I never have a sense I'm being stealthy or subverting the enemy threat when using them. I'm infiltrating through the same obvious path that everyone else will, just going through the motions so I know where my objective is and where all the guards are. There's no tension in mapping out an

Drones 'n' vents.

Red = bad, in case you were wondering.


The city's hills won't tire Marcus.


Hacking and hangovers.

The commute is cake.

arena with drones since everything is always in its designed place. It's just busywork.

There were entire floors I'd scout with a drone, sneaking by unseen to download classified files or plant a virus, only to find that Marcus' physical presence was required to tap some keys in the end. So I'd essentially replay the whole level, but as Marcus, who is easily spotted unless he's "in cover", meaning I've pushed him against a wall. I moved through the same rooms, the same guard paths and to the same objective only to die from getting caught by a guard whose red outline was barely visible against a visually busy scene. Then it's back to square one, scouting and setting up with the drone again.

At your HQ, you can 3D print everything from a shotgun to a grenade launcher. It's strange that lethal weapons are included at all, given the peaceful ends DedSec is *firing* for, and Marcus doesn't seem the type to murder. Shooting your way out of a situation isn't much fun, either. The cover system is serviceable, but with enemies that like to make a beeline for your position and with no dodge roll to dance around them, there isn't much you can do once you're flanked except run and shoot.

So the hacking abilities are too passive to be as playful as *Saints Row 4*'s superhero sandbox and the shooting feels dated in comparison to *GTA V*, which is over three years old. Without many ways to stack abilities or exploit the world and enemy AI beyond bullets and electrocution, *Watch Dogs 2* is suspended somewhere in the middle, and gets tired after 30 hours of play.

The game has a massive list of side missions. In one, you hack Ubisoft's office to leak a trailer for an unreleased game – but most want you to climb a building to tag a billboard or hack a CTOS service box for a quick scene that pokes fun at Silicon Valley bigwigs. There's a whole series of mundane missions where you just hack ATM machines and mess with terrible people trying to withdraw money, which I'd be into if it wasn't the same joke told six times via what amounts to a fetch quest. You can race your drones, drive San Franciscans around in a Crazy Taxiesque series of challenges and take selfies near famous landmarks to gain followers and upgrade your hacking skills.

As mundane as the main missions can feel, they at least take place in one of my favourite open worlds in recent memory – in a scaled-down version of the Bay Area, USA, including San Francisco, Oakland, Palo Alto and a small chunk of the Marin Headlands. San Francisco is the primary location, and it feels like a real place.

Huge sections of the city are missing, but as a big mashup of the wealthy and tourist-heavy bits, it works as a satirical backdrop for an endless stream of Silicon Valley jabs and dick jokes. But the parts it recreates are captured with eerie realism. I could intuit where famous landmarks might be located, and found them just based on my sense of direction. Most striking are the vistas. Head up a hill in the evening for a beautiful and fairly accurate skyline.

Furthermore, the user interface has been completely retooled to work with a keyboard and mouse. It doesn't make driving as precise as it is with a controller, however. If you have a controller plugged in, you can seamlessly switch back and forth, too. After the first game's dodgy PC port, it's clear Ubisoft didn't want to repeat the same mistake.

Watch Dogs 2 never made me feel Hella Cyber, but when used to leverage as much chaos as possible, it can feel like playing *GTA* with a measured God mode enabled. Silly and strange things happen often, but only if you ignore the missions and mess around in the beautifully realised open world. That's where the game's true enjoyment lies – not in its Hot Topic hacktivism and frustrating, bland stealth scenarios, but in the nonsense you can pull off in a big sandbox with wacky toys and fast cars. ■ **James Davenport**

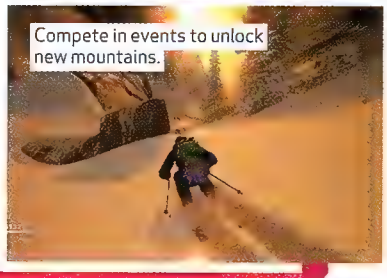
Verdict

A beautiful sandbox that lets you make your own fun, but the story mode is uninspired and stealth is unintuitive.

It's pretty up here, and while you're climbing, you might as well swing the camera around to take in the views.

You can share a custom run with friends.

A vertical strip of orange light displays your next checkpoint.


Compete in events to unlock new mountains.

FROM $89.95 | PC, PS4, XO | STEEP.UBISOFT.COM

Steep

Climb every mountain.

For a while, *Steep* feels like a bit of a muddle, even if first impressions are likely to be positive, as this vast open world of Alpine peaks can be negotiated with no loading times whatsoever. Event restarts might require you to hold down a button for a couple of seconds, but you'll be deposited back to the start line instantaneously. Choose an overview of the whole range and you'll be whisked to a 3D map, from which you can select a dropoff point. Again, once you've made your choice, there's no waiting involved.

In theory, you're able to choose from four sports on the fly by pulling up a radial menu, though that's not entirely accurate: you can't swap mid-air and you'll need to come to a standstill if you're going downhill – which can take some time when you're ragdolling off rocks after a high-speed spill. Two of the choices are all but interchangeable, as the difference in handling between skis and snowboard is negligible.

In wingsuit events, the controls are simple but the courses are often anything but, sending you swooping through narrow holes and plummeting down tunnels and twisting past jutting rocks. In other events, you're asked to glide just above ground to earn proximity points, a gentle shudder of controller feedback letting your palms know that your score is ticking upwards when your unblinking eyes are fixed upon your avatar.

This is *Steep* at its most exacting and intense, so paragliding – where you hug cliff edges to collect updrafts and gain height – is a little too sedate. It's an activity best saved for lazily taking in the sights from above, or when you need to get back up a little way and don't fancy the slow trudge on foot.

If you want to start a run not from a map pin point, you'll need to either make your own way there or use up one of your helicopter passes. Alternatively, to unlock new drop zones to which you can fast-travel, you'll need to stand within 1,000 yards of them and highlight them through your rider's binoculars.

The map proves unwieldy to navigate: those pristine slopes are pocked with icons, as is the Ubisoft way, but moving a cursor within a 3D space is clumsy, not least when it's subtly tugged towards markers you're scrolling past.

Befitting its name, *Steep*'s challenge is positively vertiginous on some of the Hard-level courses. In most cases, it's difficult in the right way, but sometimes you'll fall victim to spiteful placement of fences or wilful checkpoint positioning.

The trick system, though, is simple – this isn't *Tony Hawk* or even *SSX* where you'd be pulling physics-defying spins and flips off every ramp, but it's obtuse in its demands and peculiarly fussy in its timing. Away from the pressure of competition, it starts to feel more natural, when you have open ground stretching out in front of you and plenty of time to prepare for each jump.

As a multiplayer game, *Steep* is at its best when you're not beating your fellow boarders but simply joining them.

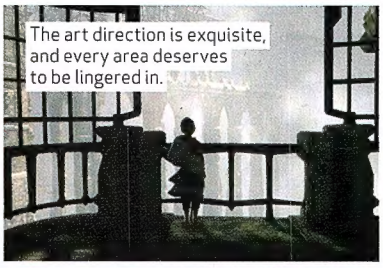
There's something quietly wonderful here when you step away from the corporate nonsense and braying thrillseekers. ■

Verdict

Combines beautiful alpine scenery and a great sense of freedom on the slopes.

★★★½☆

The world is a vertiginous wonder, filled with impossibly spindly towers, sheer cliff edges and structurally unsound bridges. Despite its size, Trico has little problem clambering about.
apc
HOT PRODUCT



$99.95 | PS4 | WWW.PLAYSTATION.COM/EN-AU/GAMES/THE-LAST-GUARDIAN-PS4

The Last Guardian

A boy's best friend.

We've been waiting a long time for this. Not the near-decade that has passed since work on *The Last Guardian* began, but rather the 15 years that have elapsed since we first sat through *Ico*'s credits, processing what we'd just experienced. In all its brave and sometimes rickety construction, *The Last Guardian* feels every bit the *Ico* sequel we've pined for during that time.

For the most part, that reassurance is provided by Trico, the creature that serves as your companion. Trico's unusual form is made up from a hotchpotch of recognisable creature – bird, dog, cat – making Trico feel real.

On your first encounter, he is injured and restrained – punctured with spears, hungry and shackled by a metal chain. Removing the broken spearheads elicits howls of pain, a violent reaction, but ultimately cautious gratitude. It's a service you provide often throughout the course of your journey, extracting projectiles after battles with the animated suits of armour that guard the towers and chambers you explore. You must also soothe the beast – a process for which you're given no instruction, requiring trial and error to get right.

Every aspect of the game is focused on developing your bond with Trico in this way – even learning basic controls or mastering new abilities never feels like a game mechanic, but rather a growing understanding between the pair of you as you gradually learn how to communicate more effectively.

This symbiosis is required to make your way through the world. In some instances, it will be a simple leg up to higher platforms. Occasionally, you'll even use Trico's dangling tail to descend into otherwise-unreachable spots.

Trico will often ignore your requests at first, or simply fail to understand what you're getting at, and while the beast is capable of moving at terrifying speed when he needs to, he mostly pads along at a mellow pace. For anyone expecting a compliant AI companion in the typical videogame mould, it will be maddening.

The game succeeds in presenting a number of puzzles the likes of which we haven't seen before. Though the solutions aren't overly complex, the mechanics feel fresh, combining imaginative physics conundrums with the need for Trico to behave in certain ways.

You are in continual danger here. The creepy animated-armour enemies move slowly, but fling runes that gradually cloud your vision and slow your movement. You can shake these off, but if an enemy grabs you, you're slung over their shoulder. Mashing buttons allows you to wriggle free, but you need to knock them off the edges of platforms to remove them permanently. More effectively, you can rely on Trico to dispatch them.

It's difficult at first to ignore issues with framerate and occasionally sticky controls, not to mention a camera that can struggle in less-spacious rooms and passageways. But it's not hard to stomach them in the context of something so generous with ideas and environments, a game so full of heart and with a character that is unlike anything we've ever seen before. ■

Verdict

Niggles aside, this game doesn't just live up to its forebears' legacy, it goes further.

★★★★½

Don't let distance get in the way

Get 'closer' with this virtual kissing simulator.

A research team from the Imagineering Lab at City University London set about trying to solve the 'problem' of long-distance relationships and have created this gadget. They say distance makes the heart grow stronger, but if there's one thing that can really kill the mood, it's the Kissenger. Utilising "high precision force sensors", then pairing with a messaging app, a user would plant a kiss on the silicon pad of the Kissenger, then it would get sent to their partner's device and the pressure signature would be replicated, simulating the kiss. *Ooh, baby*. But this isn't just meant for couples and families. The creators hope this can be used for celebrities and their fans, too. Yep, you heard right. That's the world we live in.

"Them's (virtual) fightin' words!"

THE VR GAME THAT LETS YOU BAR BRAWL WITHOUT THE RISK OF GETTING GLASSED.

While Aussie politicians are creating lock-out laws, game devs are creating virtual reality games in which the aim of the game is to get drunk and start fights in pubs. Currently available in Early Access on Steam for US$12, *Drunkn Bar Fight* surprisingly has mostly positive reviews. According to the blurb, the more you drink, the more powerful you become, which probably isn't quite the right message to promote. But hey, if you're at home, punching up AI instead of doing it on the streets, that's gotta be a step in the right direction... doesn't it?

Biometric insecurity

GIRL RACKS UP US$250 AMAZON BILL USING SLEEPING MOTHER'S THUMBPRINT.

It's the new 'sneaking into your mum's bag to pull out her purse and yoink a note or two for sweets' move, and for Ashlynd Howell, a six-year-old from Arkansas, it turned out surprisingly well. Last December, while her mother was having a nap on the couch, Ashlynd 'borrowed' her thumbprint and went on a shopping spree on the Amazon app, purchasing 13 Pokémon-related items, of which only four could be returned. Criminal genius in the making, or just die-hard fan?

Mamma mia!

HACKERS HAVE ALREADY ADDED GAMES TO THE NES CLASSIC MINI.

This is probably the one Russian hack the broader community will approve of. The hugely popular retro gaming console NES Classic Edition was released in November 2016 with 30 classic Nintendo games including *Super Mario Bros*, *The Legend of Zelda* and *Metroid*, but without the ability to buy or add more. However, that library has now been hacked by Russian hacker Madmonkey and additional games are available to play, but only if you're brave enough to attempt the difficult hack yourself. ■

PIONEER COMPUTERS

DreamVision 32" Curved All-in-One PC

- 6th Generation Desktop CPU
- 32" IPS Full HD 1920x1080 16:9
- Powerful Desktop VGA
- VR Ready Curved Screen
- Intel® Z170 Gaming M/B
- 2 SATA Drives Raid 0/1

From $1,999
RRP Inc-GST

DreamVision 32" All-in-One Gaming PC 6X

- 6th Generation Desktop CPU
- 32" IPS Full HD 1920x1080 16:9
- Powerful Desktop VGA
- IR Ready Touch Screen
- Gaming Motherboard
- Ready for Windows® 10

From $1,499
RRP Inc-GST

Unit 2/37 O'Riordan Street, Alexandria NSW 2015 · NSW (02) 9690 2888 · QLD (07) 3257 3879 · VIC (03) 8790 1830 · NZ (649) 377 0497 · Fax (02) 9690 0333
All prices include GST, exclude freight, all images are for illustrative purposes only. Errors and omissions excepted. Free 1 Year On-site Pickup & Return Warranty, 2 and 3 Years optional.
· ISO 9001 Quality Endorsed Company QEC11489 · Commonwealth Government Endorsed Supplier 263 · State, Local, Government, Education Contract Supplier

Build your own dream!

www.pioneer.net.au
1300 883 218 / sales@pioneer.net.au

THE MOST SECURE SMARTPHONE AVAILABLE TODAY

Free of Google Services Bloatware

Hardened Kernel

Evade METADATA Collection

Secure Voice Calls

Firewall & Network Hardening

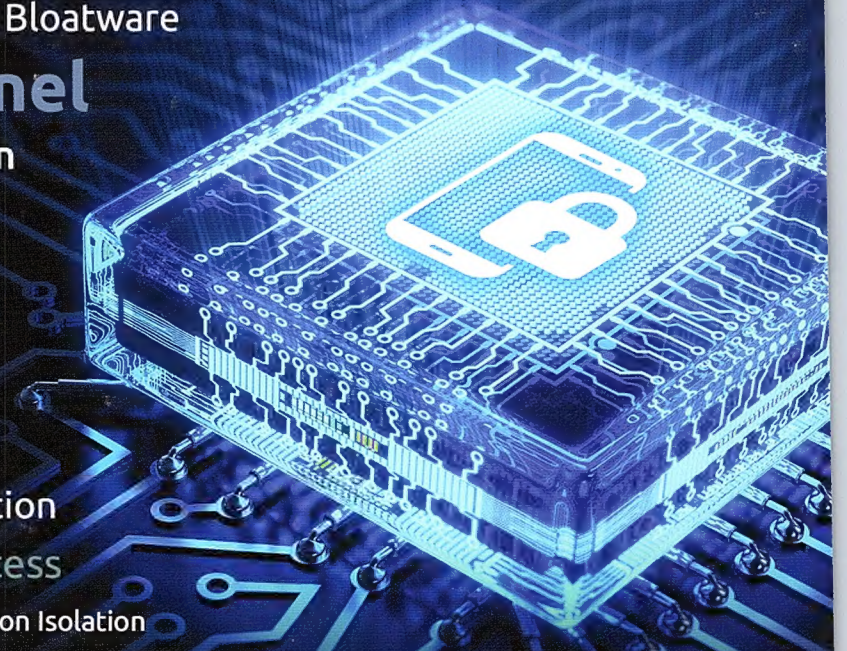
Protection from Unknown Vulnerabilities

PGP Encryption

Fake Cell Tower Detection

TOR & Deepweb Access

Application Isolation



ENCRYPTED SMARTPHONES

ON SALE NOW

Ncryptcellular offers a simple and easy to use encrypted smartphone platform in a tailored package.

Be confident yet secure that your smartphone is protected against unknown vulnerabilities and that your digital information & communications will remain secure and private through using our device.

Our smartphones are based on a completely security focused operating system, fully configured with the latest encryption and anonymizing technologies.

We've trimmed out unnecessary applications typically bundled from other manufacturers that also intrude on your privacy.

We specialise in providing secure smartphone solutions to individuals, business's and governments.

NCrypt CELLULAR

smart. safe. secure.

SPECIAL PROMOTIONAL DISCOUNT CODE

SAVE $200

CODE: APC2017

Available for a Limited Time Only

ONLY FOR APC READERS

VISIT OUR WEBSIT

or call 1800-NCRYPT

NCRYPTCELLULAR.COM.AU/AP

In partnership with

SaltDNA + COPPERHEAD